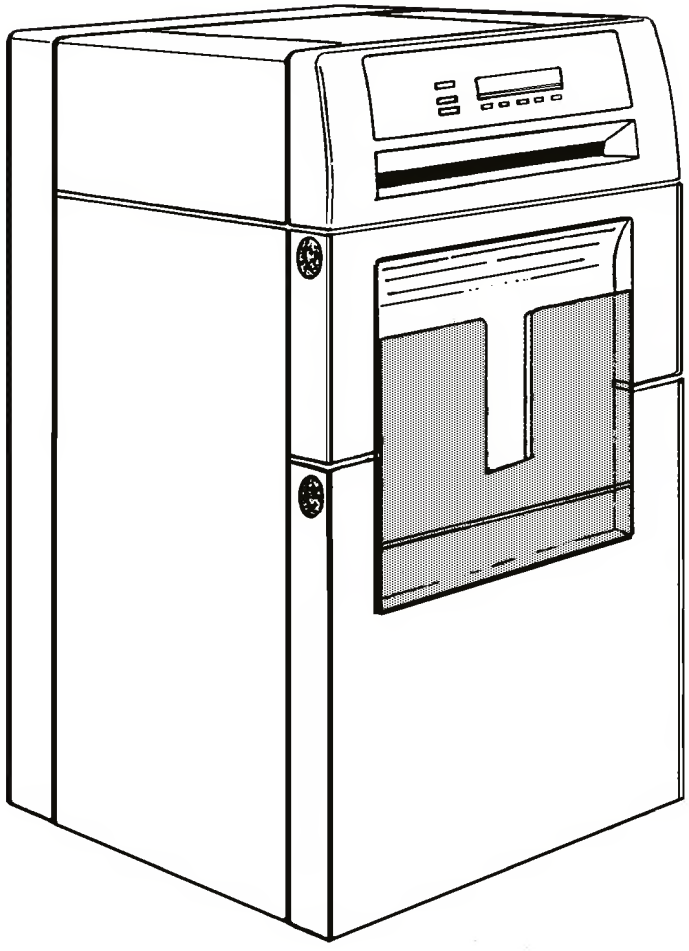
Publication No. TG 3058
10/98

supersedes Publication TG 3058 dated 3/91 and 12/92

THEORY GUIDE

for the

KODAK X-OMAT Multiloader 300 / 300 Plus



© KODAK AG STUTTGART, 1991, 1998

PLEASE NOTE

The information contained herein is based on the experience and knowledge relating to the subject matter gained by Kodak prior to publication.No patent license is granted by this information. Kodak reserves the right to change this information without notice, and makes no warranty, express or implied, with respect to this information. Kodak shall not be liable for any loss or damage, including consequential or special damages, resulting from the use of this information, even if loss or damage is caused by Kodak's negligence or other fault.

TABLE OF CONTENTS

CHAPTER 1 1-1

PURPOSE OF THE KODAK X-OMAT MULTILOADER 300 / 300 Plus 1-2

SEQUENCE OF A NORMAL CYCLE: 1-2

SYSTEM OVERVIEW 1-3

MECHANICAL SYSTEM 1-3

PNEUMATIC SYSTEM 1-6

FILM POCKET 1-8

CASSETTE SUCKER BAR AND BLOW PIPES 1-9

MOTORS 1-10

SENSORS AND SWITCHES 1-12

OPTICAL FLAGS 1-12

SENSOR 1-13

ODOMETER 1-13

REFLECTIVE SENSORS 1-13

B25 / B26 FILM DETECTOR SENSORS (ML300 Plus only) 1-20

ELECTRONIC SYSTEM 1-21

POWER SUPPLY 1-21

PRINTED CIRCUIT BOARD A1 1-21

PRINTED CIRCUIT BOARD A2 1-22

PRINTED CIRCUIT BOARD A3 (SLAVE PROCESSOR) 1-22

PRINTED CIRCUIT BOARD A4 MAGAZINE INTERFACE 1-24

PRINTED CIRCUIT BOARD A5 FILM POCKET 1-26

PRINTED CIRCUIT BOARD A6/1-3 MAGAZINE SENSE 1-27

PRINTED CIRCUIT BOARD A7 LEVEL CONTROL 1-28

PRINTED CIRCUIT BOARD A8 CASSETTE INTERFACE 1-28

PRINTED CIRCUIT BOARD A9 DC MOTOR DRIVER 1-28

PRINTED CIRCUIT BOARDS A10/1-3 ODOMETER 1-29

CHAPTER 2 2-1

SOFTWARE 2-2

SEQUENCE OF OPERATION 2-8

CHAPTER 1

PURPOSE OF THE KODAK X-OMAT MULTILOADER 300 / 300 Plus

Note

For the sake of simplicity the KODAK X-OMAT MULTILOADER 300 / 300 Plus is called hereafter XML300 in this publication.

The XML300 is a daylight handling system for radiographic films. The XML300 consists of a Film Processor 270RA (or 3000RA for the XML300 Plus), a XML300 (or ML300 Plus) and Cassettes (IC, Video Film Holders or Mammography).

SEQUENCE OF A NORMAL CYCLE:

A cassette contains an exposed radiographic film.(1)

The cassette is fed into the XML300. (2)

The XML300 opens the cassette and removes the exposed film. (3)

The film is transported through the film processor. (4)

The film leaves the film processor after it has been processed. After the cassette has been unloaded theXML300 puts a fresh film into the cassette. (5)

After the cassette has been reloaded the XML300 closes and feeds out the cassette.

XML300

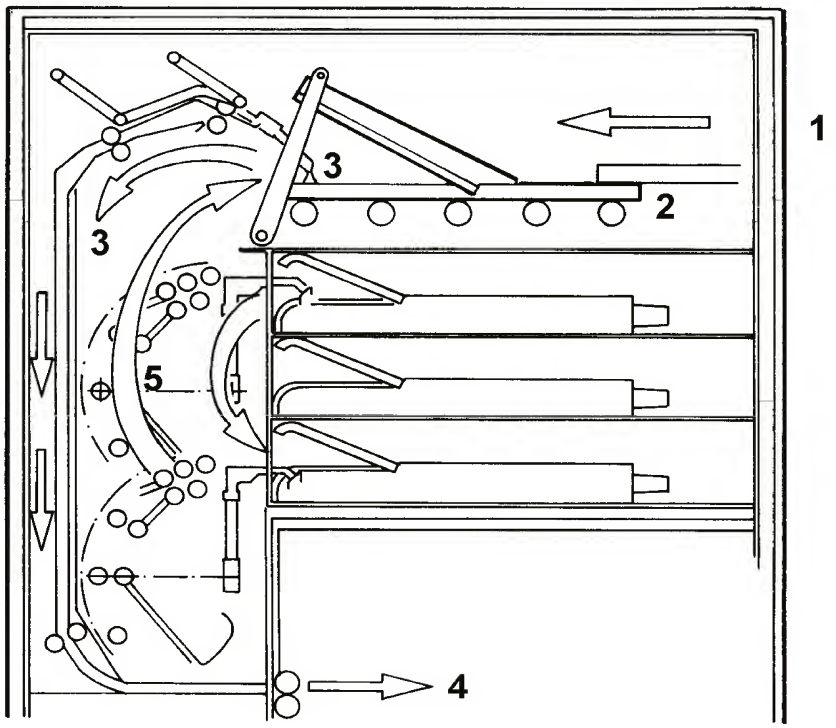


figure 1-1

SYSTEM OVERVIEW

The XML300 contains the following basic systems:

- Mechanical System
- Electromechanical System
- Electronic System
- Software

The Mechanical System is divided into the following subsystems:

- Frame
- Cassette Entry
- Conveyor. Film Chute
- Processor Interface
- Magazine Holder
- Film Pocket

The Electromechanical System consists of:

- Compressor System
- Vacuum System
- Motors
- Fans

The Electronic System consists of:

- Circuit Boards
- Sensors
- Power Supply

MECHANICAL SYSTEM

1. Frame

Purpose of the frame:
It holds all the modules of the XML300 in the proper position.The frame is a riveted stainless steel construction.

2. Cassette Entrance

Purpose of the Cassette Entrance:

The Cassette Entrance detects the cassette when it is fed into or out of the XML300 and can be closed to make the system light tight.

The Cassette Entrance consists of:
A pair of rollers, a sensor assembly to detect cassettes and an Input Flap to close the entrance.

3. Cassette Transport

Purpose of the Cassette Transport:
The cassette transport mechanism transports the cassette to the correct position where it can be opened, unloaded and loaded. In addition the cassette size is measured. The cassette transport mechanism feeds out the cassette after it has been loaded with a fresh film.

The Cassette Transport consists of:

- A roller transport mechanism for feeding the cassette in and out.
- A holding finger to move the cassette close to the mechanical end stop for the cassette, after feeding in and to measure the cassette width.
- Two Centering Bars to move the cassette in a centred position between left and right and to measure the Cassette Length.

4. Cassette Opener

Purpose of the Cassette Opener:

The Cassette Opener opens and closes the cassette.
The Cassette Opener consists of:
The opener bar with a moveable opener wedge and two moveable hooks.

5. Conveyor

Purpose of the Conveyor:

The Conveyor removes the exposed film from the cassette and transports the film to the Film Chute.

The Conveyor consists of:

- The Sucker Bar Carriage to remove the film from the cassette.
- The roller transport mechanism to transport the film to the Film Chute.

6. Film Chute

Purpose of the Film Chute:
The Film Chute guides the exposed film from the Conveyor to the Processor Interface.

The Film Chute consists of:

- A moveable Fume Trap at the entrance.
- A Flap used to align and to control the timing of the film at the bottom side of the Film Chute.

7. Processor Interface

Purpose of the Processor Interface:
The Processor Interface transports the exposed film from the Film Chute to the Film Processor. The transport speed of the film in the Processor Interface is variable. The Processor Interface always transports the film at the same speed as the Film Processor.

The Processor Interface consists of:

- A frame with a sliding plate.
- Two pairs of transport rollers.

8. Magazine Holder

Purpose of the Magazine Holder:
The Magazine Holder holds the three magazines in the correct position. The magazine becomes unlatched when it is inserted in the Magazine Holder. The Magazine Holder also opens and closes the magazine lids by a bracket.

The Magazine Holder consists of:

- 6 guides to hold and to unlatch the 3 magazines.
- A spring loaded bracket to lift the magazine lids.

9. Film Pocket assembly

Purpose of the Film Pocket Assembly:
The Film Pocket takes a film from the magazine and puts it into the cassette.

The Film Pocket Assembly consists of:

- A Sucker Bar Assembly to grasp the film.
- Two deflectors to make sure that only one film is taken out of the magazine.
- A Double Film Detector to detect if a second film sticks to the film which has been taken out of the magazine.
- A Sensor to detect if the magazine is empty.

PNEUMATIC SYSTEM

The Pneumatic System consists of:

- 6 solenoid valves
- A compressor
- A bleeder valve
- A strainer with a water trap
- Two sucker bars to pick up film
- Two sets of blow pipes for film separation

The compressor is used to generate the vacuum and the pressure for the entire pneumatic system. The Magazine Sucker Bar is used to pick up the film from the magazines. The blow pipes on the Magazine Film Pocket are used to separate the films in the magazine to avoid double film loading in the cassette. The Cassette Sucker Bar is used to pick up the exposed film from the cassette and to deliver it to the roller transport mechanism.

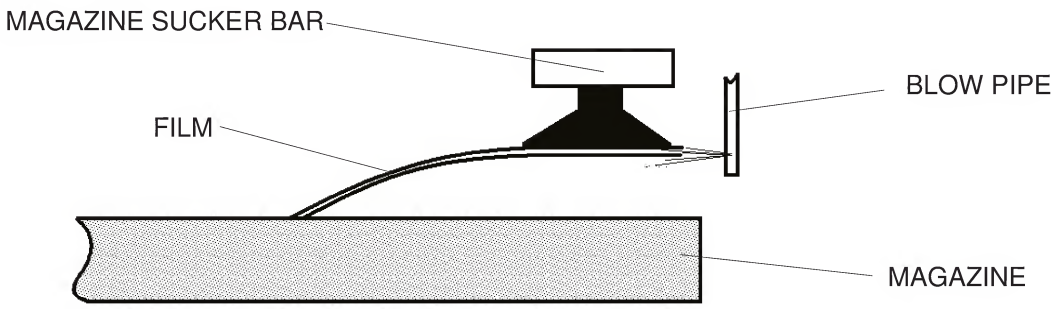


figure 1-2

The blow pipes at the cassette centering bars are used to separate the film from the cassette lid. These blow pipes use the effect of an air flow over a surface creating a vacuum above this surface to suck the film from the cassette lid. The Bleeder valve switches when the pressure has reached 4 bars. This limits the pressure to 4 bars.

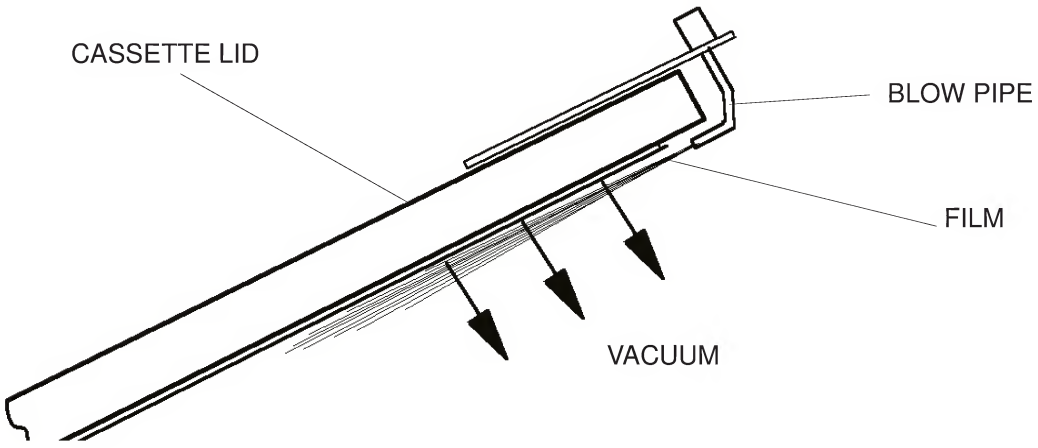


figure 1-3

The strainer and the water trap protect the magnetic valves against dirt and humidity.

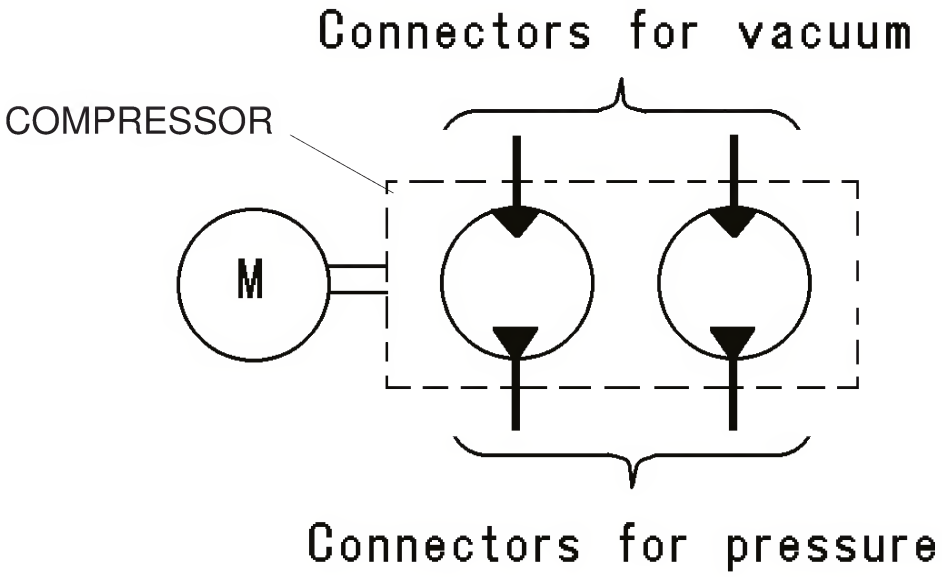


figure 1-4

The symbol for the solenoid valves should be read as shown in the figure below. The right hand position is the position if the solenoid valve is deenergized.

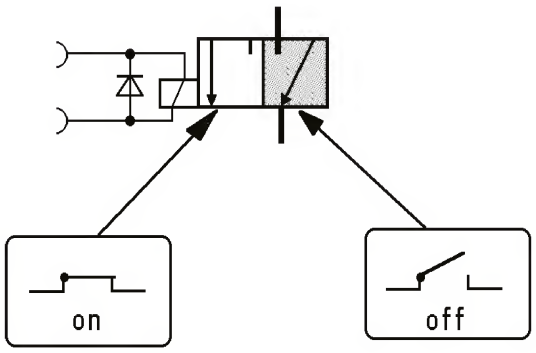


figure 1-5

FILM POCKET

For the correct operation of the pneumatic system it is necessary that the compressor can suck air during the venting of the blow pipes. The air is supplied by the solenoid valve Y12 to create the vacuum at the magazine suckers, the compressor also has to bleed air.

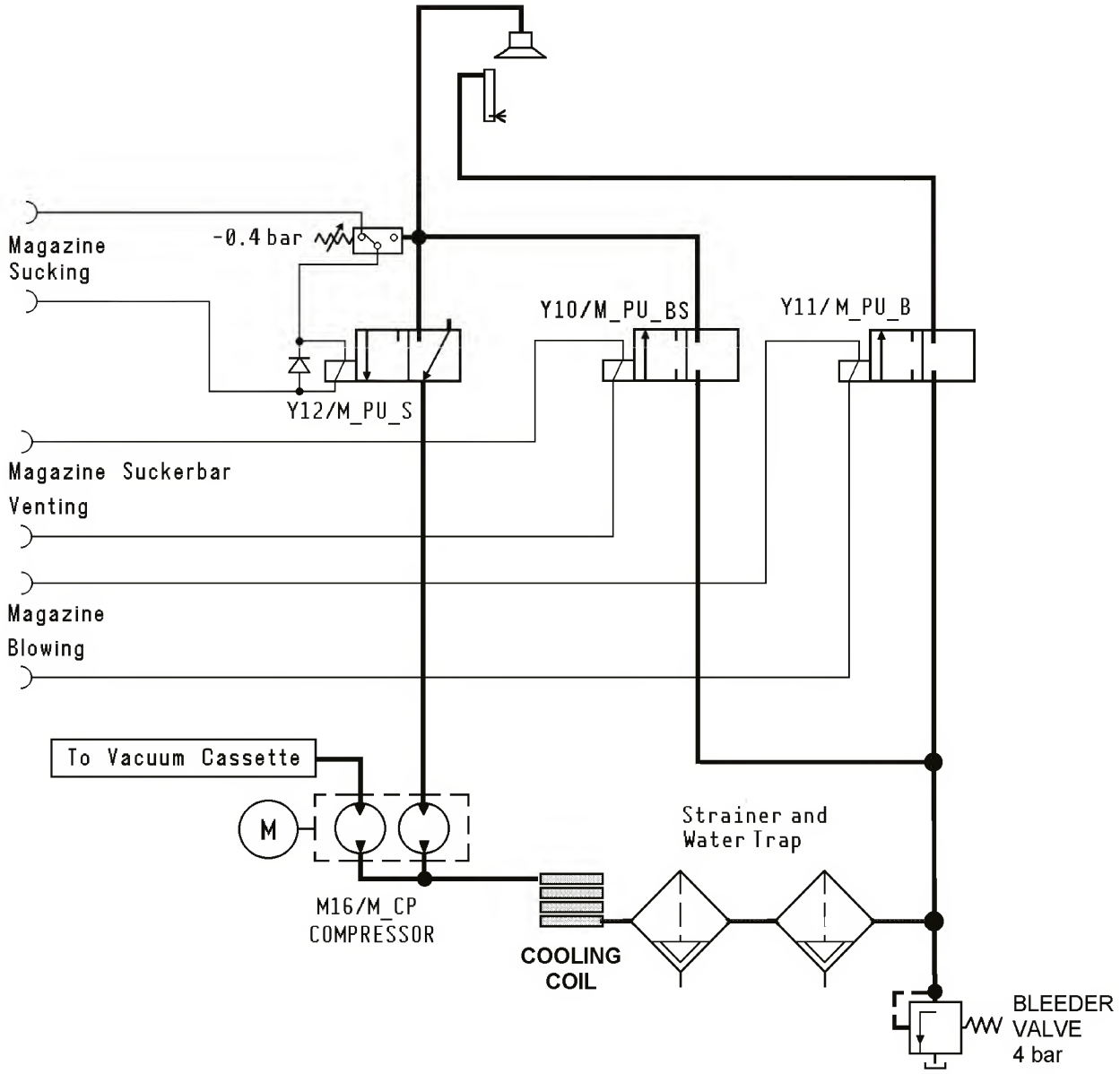


figure 1-6

CASSETTE SUCKER BAR AND BLOW PIPES

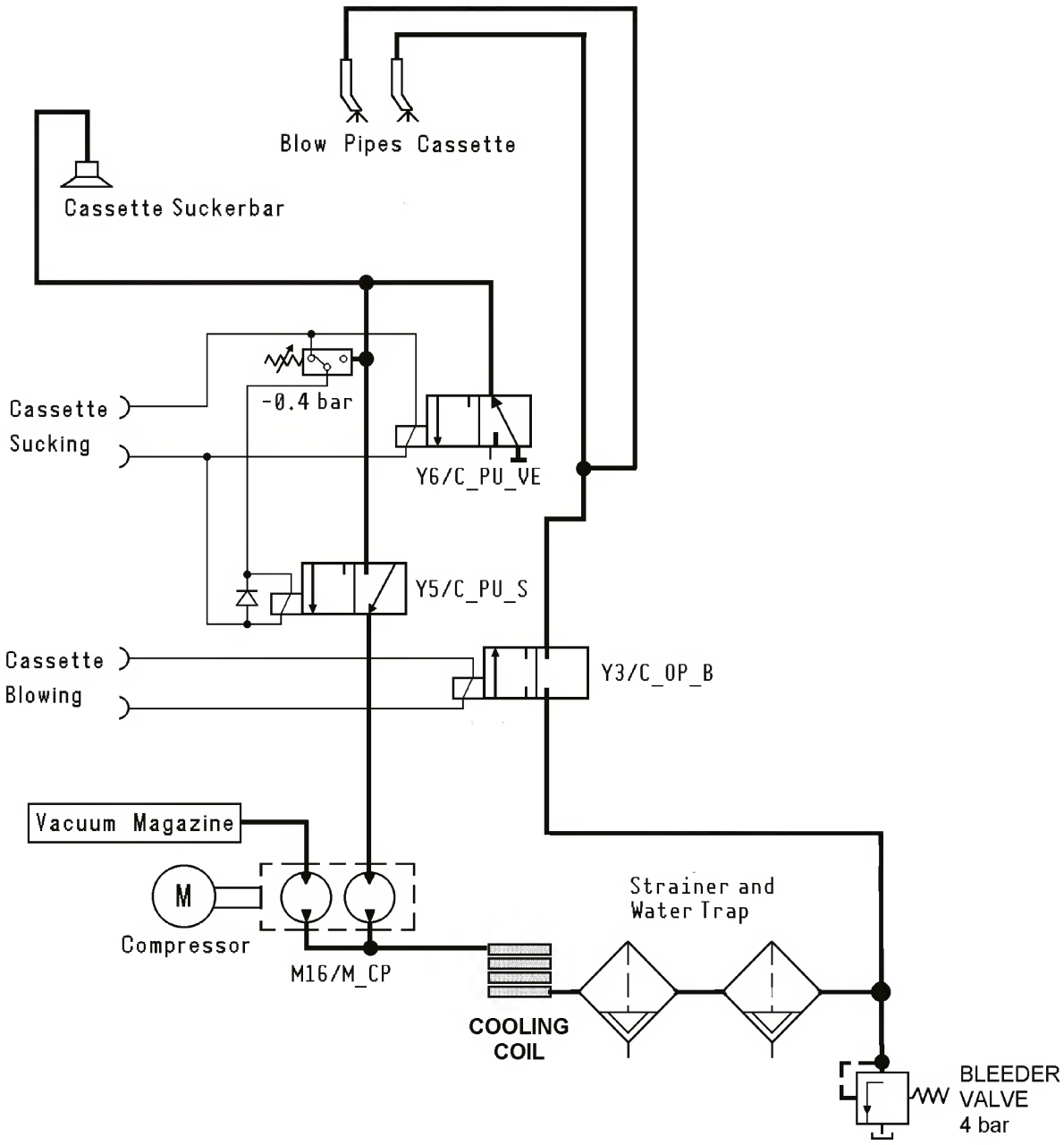


figure 1-7

MOTORS

All AC-motors have an operating voltage of 115 Volts and can be used with 50 Hz or 60 Hz.

Motor M1 (Input Flap)

The Motor M1 opens and closes the Cassette Input Flap. Motor M1 is a synchronous motor with an operating voltage of 115 Volts AC. The position of the Cassette Input Flap is detected by two sensors at the Cassette Input Flap. Sensor B3/C_IF_EO is actuated when the Cassette Input Flap is completely opened. Sensor B4/C_IF_EC is actuated when the Cassette Input Flap is completely closed.

Motor M2 (Cassette Input)

Motor M2 is a DC motor with an operating voltage of 20 volts. It can be driven forward and reverse. The Motor M2 drives the rollers which transport the cassette into and out of the XML300. The motor becomes switched on when a cassette is detected by the Sensor B2/C_IN_R on the roller assembly at the entrance of the XML300. The motor is switched off when at least two of the three Sensors B5/C_IN_EL, B6/C_IN_EM, B7/C_IN_ER at the Cassette Stop are actuated by the leading edge of the cassette. For the feed out of the cassette the Motor M2 is switched off a short time after the cassette has been detected by Sensor B2/C_IN_R at the entrance of the XML300. This time before the Motor M2 is switched off is determined by the cassette width:
If the cassette width =< 315 mm, the time before Motor M2 is switched off, is 320 msec.
If cassette width > 315 mm, the time before Motor M2 is switched off, is 700 msec.

Motor M3 (Holding Finger)

The Motor M3 is a 115 volt AC Motor. This motor moves the Holding Finger forward and reverse. The Sensor B8/C_HF_W measures the width of the cassette by counting the pulses caused by the movement of the timing disc between the Sensor B8/C_HF_W. Sensor B8/C_HF_W is also used to detect the home position and the end positions of the Holding Finger. When the Holding Finger reaches the cassette or one of its mechanical end stops the Motor M3 becomes blocked and the timing disc stops turning. Thus the Sensor B8/C_HF_W will stop generating pulses. If there is no pulse from the Sensor B8/C_HF_W for 30 milliseconds, the XML300 assumes that the Holding Finger has reached a mechanical stop and the Motor M3 becomes switched off.

Motor M4 (Cassette Centering)

The Motor M4 is a 115 volt AC-motor. This motor moves the Cassette Centering Bars in and out. Several sensors are actuated during the centering and the decentering of the cassette: Sensor B10/C_CE_EO actuates when the Centering Bars are in the outermost position. Sensor B9/C_CE_EC is actuated when the Cassette Centering Bars are in their innermost position. Sensor B11/C_CE_CL and Sensor B12/C_CE_CR are actuated when a cassette is clamped between the cassette Centering Bars. Sensor B13/C_CE_L measures the length of the cassette. When the Cassette Centering Bars are moving to the center the timing disc turns which causes the Sensor B13/C_CE_L to send out pulses. These pulses are used to measure the cassette length.

Motor M5 (Cassette Opening)

The Motor M5 is a 20 volt DC motor. This motor is used to lift the Cassette Lid. Sensor B15/C_OP_EO is actuated when the Cassette Opener is in its uppermost position. Sensor B14/C_OP_P (on Odometer A10/3) together with a timing disc measures the position of the Cassette Opener in relation to the uppermost position.

Motor M6 (Cassette Film Pickup)

Motor M6 is a 115 volt AC motor. This motor moves the Sucker Bar Carriage into the cassette and back into Home Position. The position of the Cassette Sucker Bar is detected by two sensors. Sensor B17/C_PU_ER is actuated when the Cassette Sucker Bar is in the Home Position. Sensor B18/C_PU_EF is actuated when the Cassette Sucker Bar is in the Cassette. Both sensors consist of a transceiver. They send out an infrared light beam and they can detect infrared light. On the left hand drive belts is a small mirror that reflects the light back to the sensors when the Cassette Sucker Bar is in the correct position.

Motor M7 (Roller Motor)

The Motor M7 is a 115 volt AC-motor. This motor drives the roller transport mechanism in the Conveyor. The Motor M7 is switched on by the Slave Processor on the Circuit Board A3 after the vacuum for the Cassette Sucker Bar has been switched on for the unloading of the Cassette. The Motor M7 becomes switched off when the cassette has been fed out of the XML300.

Motor M10 (Film Pocket Stepper Motor)

Motor M10 is a stepper motor. This motor moves the Film Pocket to the different Magazine Levels, to the Cassette Level and to the Home Position. The position of the FILMPOCKET is detected by sensors.

Motor M11 (Interface Flap)

Motor M11 is a 115 volts AC motor. This motor opens and closes the flap at the entrance of the Film Chute. Sensor B33/M_PI_F is actuated when the flap is closed.

Motor M12 (Film Release Flap, Chute)

Motor M12 is a 115 volts AC motor. This motor opens and closes the Film Release Flap at the bottom side of the Film Chute. Sensor B34/M_PI_R is actuated when the Film Release Flap is closed.

Motor M13 (Processor Interface Stepper Motor)

Motor M13 is a stepper motor. This motor drives the transport rollers of the Processor Interface. The speed of this motor is set to the same speed as the Film Processor. This is done automatically by the software.

Motor M14 (Magazine Opening)

The Motor M14 is a 115 volts AC motor. This motor opens and closes the magazines. The open position of the Motor M14 is detected by Sensor B36 M_OP_EO. The close position of the Motor M14 is detected by Sensor B37 M_OP_EC.

Motor M15 (Magazine Sucker Bar)

Motor M15 is a 115V AC motor. This motor moves the Magazine Sucker Bar in and out. The front position (Sucker Bar in) is used to take out a fresh film from a magazine and to put the fresh film into the cassette. The front position of the Magazine Sucker Bar is detected by Sensor B56/M_PU_EF. The rear position is used to transport the new film in the Film Pocket from the magazine to the Cassette Level. The rear position is detected by Sensor B58/M_PU_ER on the Printed Circuit Board A5. The middle position is the Home Position of the Magazine Sucker Bar when there is no film at the Magazine Suckers. The middle position is between the rear position and the front position of the Magazine Sucker Bar. The middle position is detected by Sensor B57/M_PU_M on the Printed Circuit Board A5.

Motor M16 (Compressor)

The Motor M16 drives the whole pneumatic system. That means the compressor supplies the vacuum and the pressure. For details see description of the Pneumatic System.

SENSORS AND SWITCHES

In the XML300 different types of sensors are used although the electronic symbol for all of them is the same. In all manuals they are all called sensor only. The differences between them are the mechanical configurations.

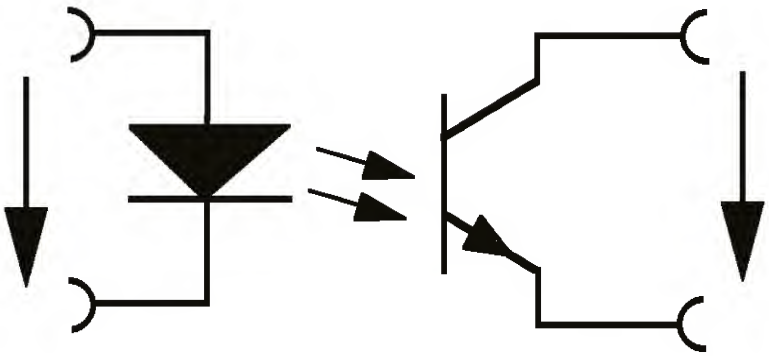


figure 1-8

OPTICAL FLAGS

The Optical Flag looks similar and is mechanically applied like a switch. The actuator is spring loaded. In the non actuated position the actuator interrupts the light beam between the transmitter and the receiver. When the actuator is actuated the light beam from the transmitter passes to the receiver.

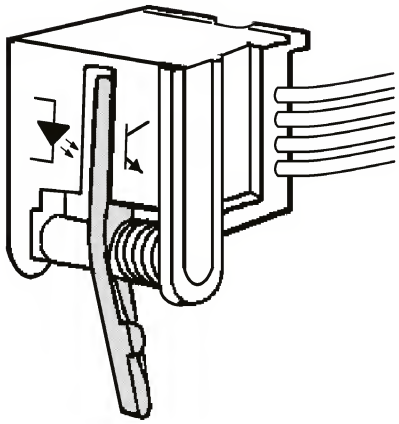


figure 1-9

SENSOR

This sensor is used in two applications:

To detect mechanical positions by being interrupted by a bracket.To measure distances and to detect mechanical positions in combination with a rotating timing disc. This kind of assembly is called Odometer.

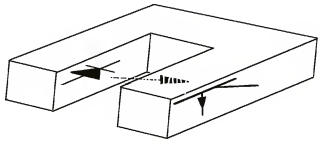


figure 1-10

ODOMETER

This type of sensor is used for position detections by measuring rotations in fixed steps. It can also detect the direction of the rotation.

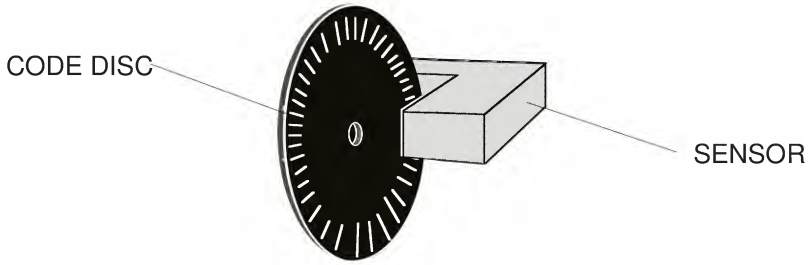


figure 1-11

REFLECTIVE SENSORS

In this sensor the receiver and the transmitter are located in parallel. To actuate the sensor, the light beam from the transmitter is reflected back to the receiver. This is done by a mirror or a reflective foil.

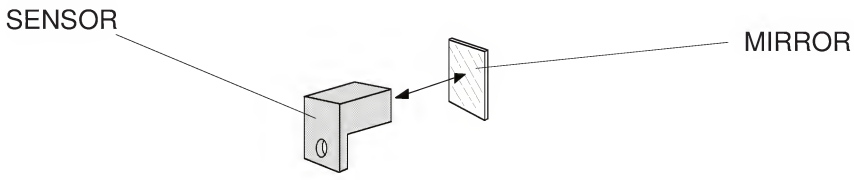


figure 1-12

B1/C_FD Switch, Front Door

This switch is actuated when the front door is closed.

B2/C_IN_R Cassette Registration

This Sensor (Optical Flag) is located at the entrance of the XML300. The Sensor B2/C_IN_R detects the cassette at the entrance of the XML300.

B3/C_IN_EO Cassette Input Flap End Switch Open

This Sensor (Optical Flag) is actuated when the Cassette Input Flap is completely opened.

B4/C_IF_EC Cassette Input Flap End Switch Closed

This sensor (Optical Flag) is actuated when the Cassette Input Flap is closed completely.

B5/C_IN_EL, B6/C_IN_EM, B7/C_IN_ER Cassette In End Switch, Left, Middle, Right.

These three sensors (Optical Flags) are used to detect the cassette at the Cassette Stop. There are three sensors used for to make sure that the leading edge and not only a corner of the cassette is located at the cassette stop. Therefore at least two sensors have to be actuated to generate the message that the cassette is at the Cassette Stop.

B8/C_HF_W Cassette Width Detection

This sensor is a part of the Odometer A10/1. It is used to measure the cassette width.

B9/C_CE_EC, B10/C_CE_EO Center Bars Closed End Switch, Opened End Switch

The Sensors B9 and B10 (Optical Flags) are used to detect the innermost (B9) and the outermost (B10) position of the two Centering Bars.

B11/C_CE_CL, B12/C_CE_CR Cassette Centred Left/Right

These two sensors (Optical Flags) are used to detect that the cassette is centred between the Cassette Centering Bars. The cassette is centred only when both sensors are actuated.

B13/C_CE_L Cassette Length Detection

This sensor is a part of the Odometer A10/2. It is a used to measure the cassette length.

B14/C_OP_P Cassette Opener Position

This sensor is a part of the Odometer A10/3. It is used to detect the middle and the bottom position of the Cassette Opener Assembly.

B15/C_OP_EO Cassette Opener End Switch Open

This sensor (Optical Flag) is used to detect the open position of the Cassette Opener.

B16/C_OP_RO Cassette Really Opened

This sensor is used to detect whether the cassette is really opened after the Opener Assembly has reached the Sensor B15 (Cassette Opener). The Sensor B16 becomes actuated by the lid of the cassette.

B17/C_PU_EF, B18/C_PU_ER Film Pick Up Front/Rear End Switches

These two sensors are used to detect the front and the rear position of the Cassette Sucker Bar Carriage. The front position B17 of the Cassette Sucker Bar Carriage is the position where the sucker bar is located in the cassette. The rear position (B18) is the home position of the Cassette Sucker Bar Carriage. The two sensors are located opposite to the left hand drive belt of the Cassette Sucker Bar Carriage. The mirror for the detection is located on the drive belt.

B19/C_PU_T Cassette Sucker Bar Tilt

This sensor (Optical Flag) is used to detect if the Cassette Sucker Bar is in the Tilt Position. The purpose of the tilting of the Cassette Sucker Bar:
To separate the film from the screen in the cassette.

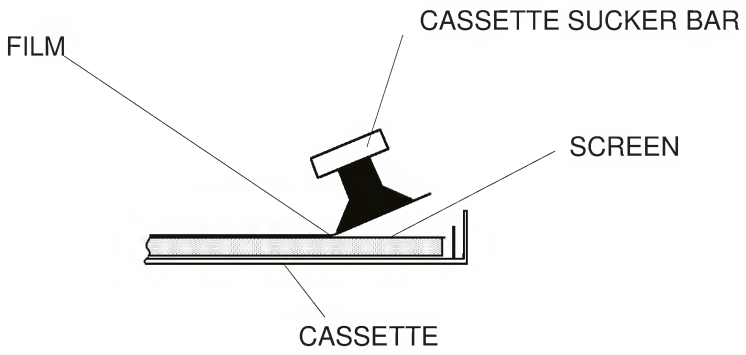


figure 1-13

To detect if there is a film in the cassette. If there is no film in the cassette it is not possible to tilt the Cassette Sucker Bar because the Cassette Sucker Bar will stick to the screen of the cassette. The XML300 will detect the cassette as empty when the Sensor B19 C_PU_T is not actuated after the tilting of the Cassette Sucker Bar has been switched on. This function is not used with Mammo Cassettes and Video Film Holders (CRT Cassettes) because there is no screen at the bottom (tube) side of these cassettes.

B20/C_PU_VO Vacuum Off

This sensor is located at the entrance of the Conveyor. The signal of Sensor B20/C_PU_VO is used to switch off the vacuum of the Cassette Sucker Bar. After the Cassette Sucker Bar has been tilted, the Sucker Bar Carriage moves to the rear position. The film is put between the rollers at the entrance of the Conveyor before the Sucker Bar Carriage is at the rear (home) position. Therefore the vacuum on the Cassette Sucker Bar has to be switched off before the Sucker Bar Carriage has reached the rear position. Otherwise film jams would occur in the Conveyor. The vacuum is switched off a short time after the leading edge of the film has reached the Sensor B20/C_PU_VO. See figure 1-14 on the next page.

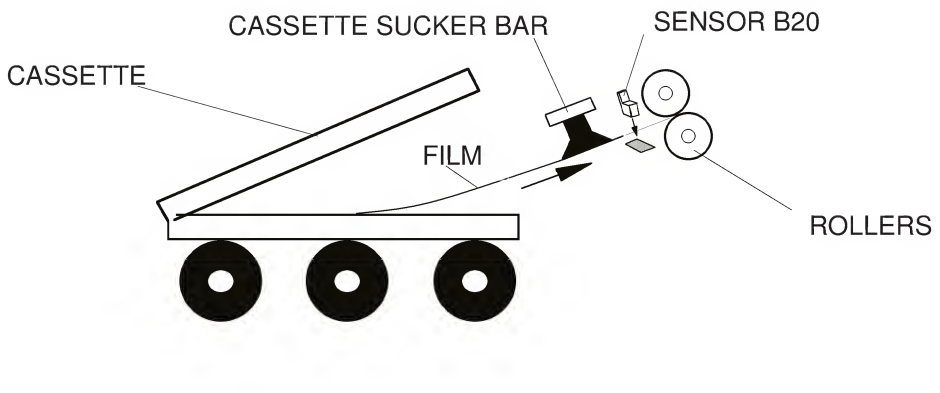


figure 1-14

B21/C_T2_L, B22/C_T2_R: Film Type 2 Detection Left/Right

These two sensors are located on the two Centering Bars. After the cassette has been centred and the Holding Finger has been moved to the cassette, the XML300 reads the status of the Sensors B21 and B22. If at least one of the sensors is actuated the XML300 detects the cassette as type 2. The sensors are actuated by a reflective foil which is installed to the top cover of the cassette.

B30/M_PO_HP Home Position, B31/M_PO_ES End Switch, B32/M_PO_ML Mag. Level

Sensor B30/M_PO_HP Home Position is used to detect the Home Position of the Film Pocket Assembly.

Sensor B31/M_PO_ES End Switch is used to detect whether the Film Pocket Assembly is out of the normal range in the top or the bottom. Sensor B31 is only actuated in cases of failures of the Sensor B32 or the Stepper Motor M10 Film Pocket.

Sensor B32/M_PO_ML Magazine Level is used to detect the correct positions of the Film Pocket at the magazines and the Cassette Level, where the Magazine Sucker Bar can move into the magazines or the cassette.

B33/M_PI_F Interface Flap Closedœ

B33/M_PI_F Interface Flap Closed is actuated when the Interface Flap of the Film Chute is closed.

B34/M_PI_R Film Release Closed

SENSOR B34/M_PI_R is actuated when the Film Release of the Film Chute is closed.

B35/M_PI_B Film In Interface Bottom

Sensor B35/M_PI_B detects a film at the Film Release. Sensor B35/M_PI_B is the last sensor in the XML300 which senses the exposed film after the unloading of the cassette.

B36/M_OP_EO Mag. Open. End Switch Open, B37/M_OP_EC Mag Closing End Switch

These two sensors detect the positions of the opener assembly of the magazines.

B43/M_CD_1, B49/M_CD-2, B55/M_CD_3 Magazine Closed Detection

These three sensors are actuated by a reflective foil on the magazine lids. One sensor is used per Magazine Level.

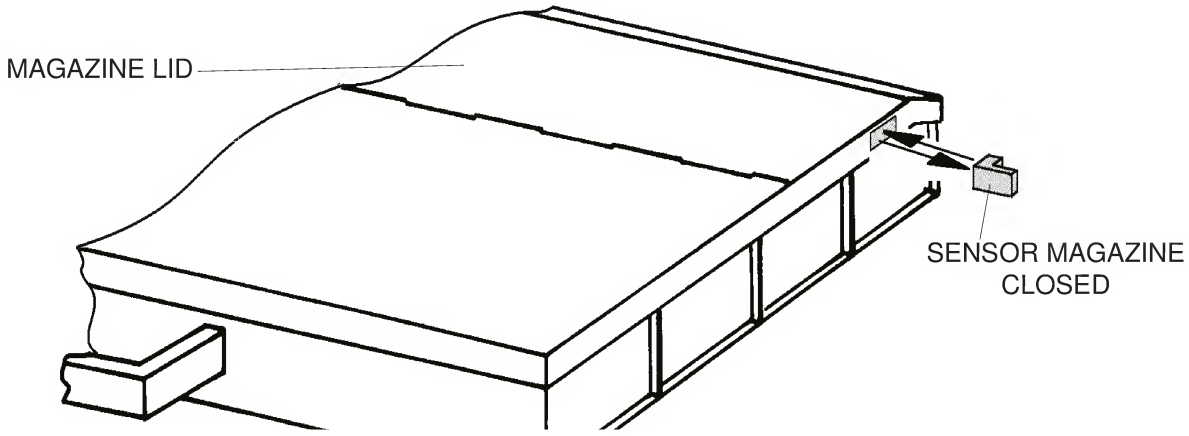


figure 1-15

B43/M_CD_1: Magazine Level 1.
B49/M_CD_2: Magazine Level 2.
B55/M_CD_3: Magazine Level 3.

Each sensor is actuated when the magazine lid is closed.

B38, B39, B40, B41, B42 (/M_SD_11-15), B44, B45, B46, B47, B48 (/M_SD_21-25), B50, B51, B52, B53, B54 (/M_SD_31-35)

These sensors are located on the Printed Circuit Boards A6/1-3. They are used to detect the film sizes of the magazines. The sensors are actuated by code brackets which are installed to the rear side of the magazine. For more details of the function of these sensors see description of Printed Circuit Board A6.

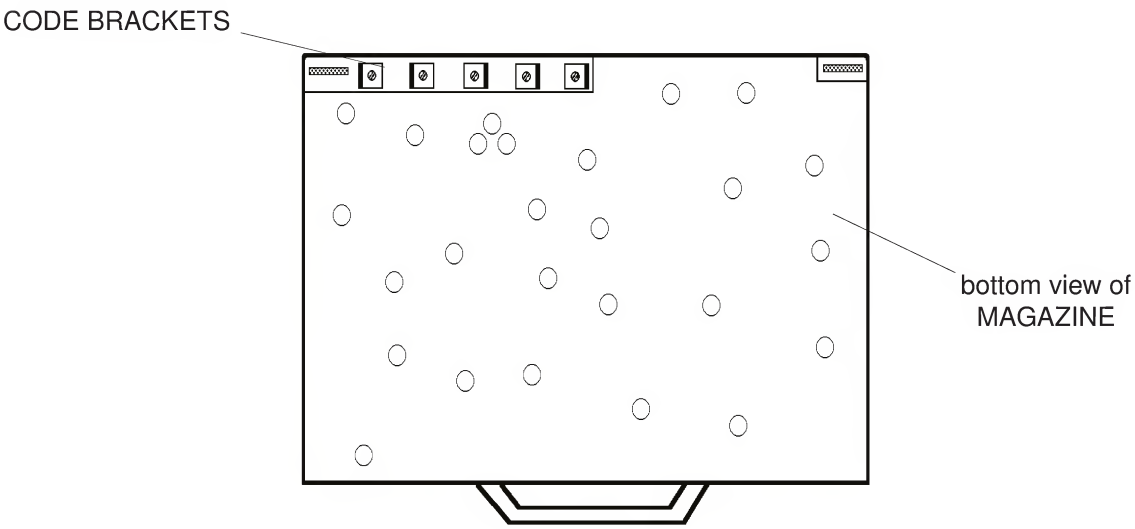


figure 1-16

B56/M_PU_EF Film Pickup Front End Switch, B57/M_PU_M Film Pick Up Middle Position, B58/M_PU_ER Film Pickup Rear End Switch

These three sensors are located on the Printed Circuit Board A5. They detect the positions of the Magazine Sucker Bar.

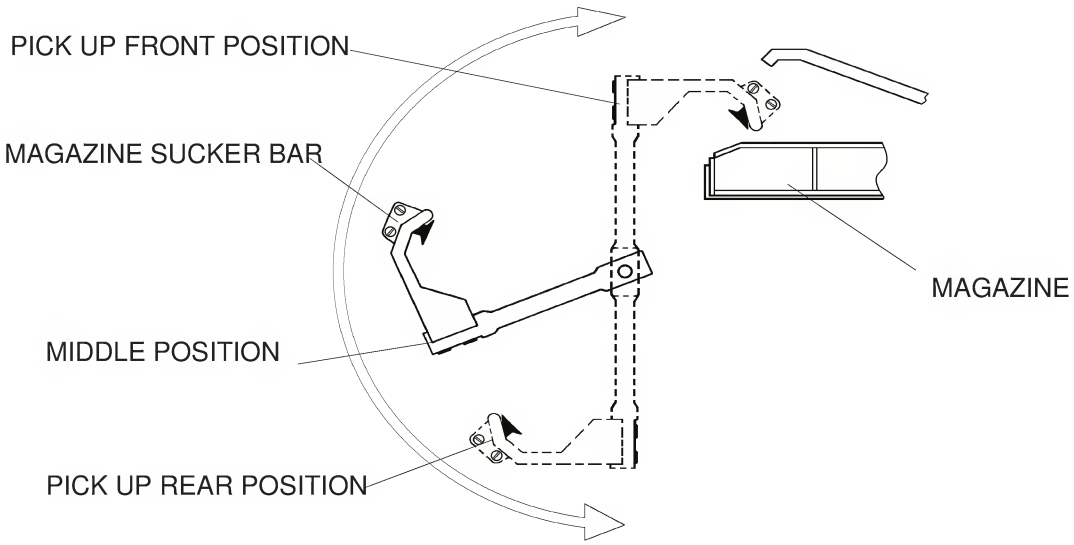


figure 1-17

B59/M_PU_DS Double Sheet Detector

The Double Film Detector measures the thickness of film before the Magazine Sucker Bar moves out of the magazine. Sensor B59/M_PU_DS is actuated when the measured thickness of the film is above 0.3 mm. The thickness of one film is about 0.2 mm. Therefore the XML300 assumes that a thickness above 0.3 mm has to be caused by a second film sticking to the film at the Magazine Sucker Bar.

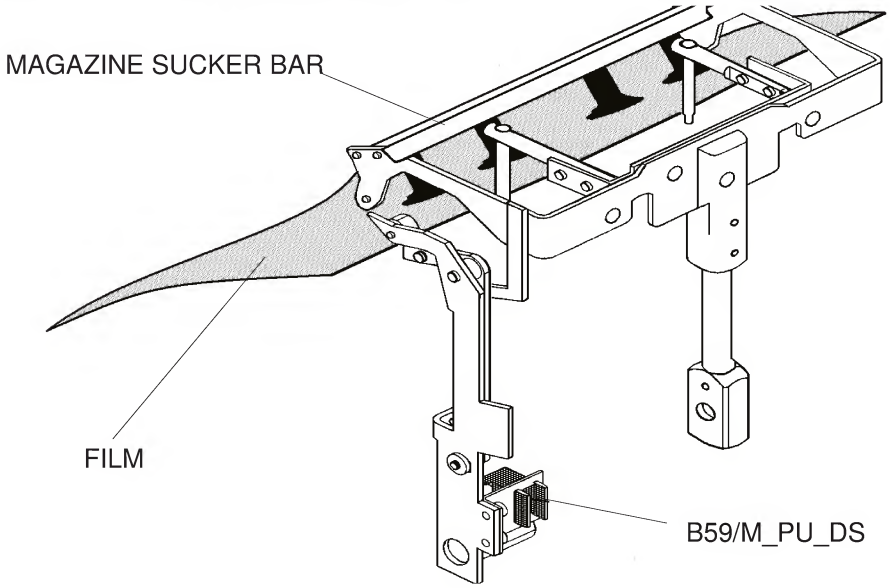


figure 1-18

B60/M_PU_E Magazine Empty

This sensor consists of a transceiver. This means it sends and detects an infrared light beam. Sensor B60/M_PU_E is actuated when the magazine is empty. The light beam coming from the Sensor B60/M_PU_E becomes reflected by a mirror on the Magazine Sucker Bar into the magazine. The light beam is directed to a spot on the bottom of the magazine where a reflective foil is placed. As long as there is a film in the magazine the light beam becomes absorbed by the surface of the film. To insure the films do not become exposed by the Sensor B60 the transmittor is switched on by pulses to reduce the amount of light. When there is no film in the magazine the reflective foil reflects the light beam via a mirror back to the Sensor B60. The sensor is read before the Magazine Sucker Bar moves into the magazine and when the Magazine Sucker Bar moves from the Pick Up Front Position to the Pick Up Rear Position. This enables the XML300 to detect that a magazine is empty by removing the last film from the magazine.

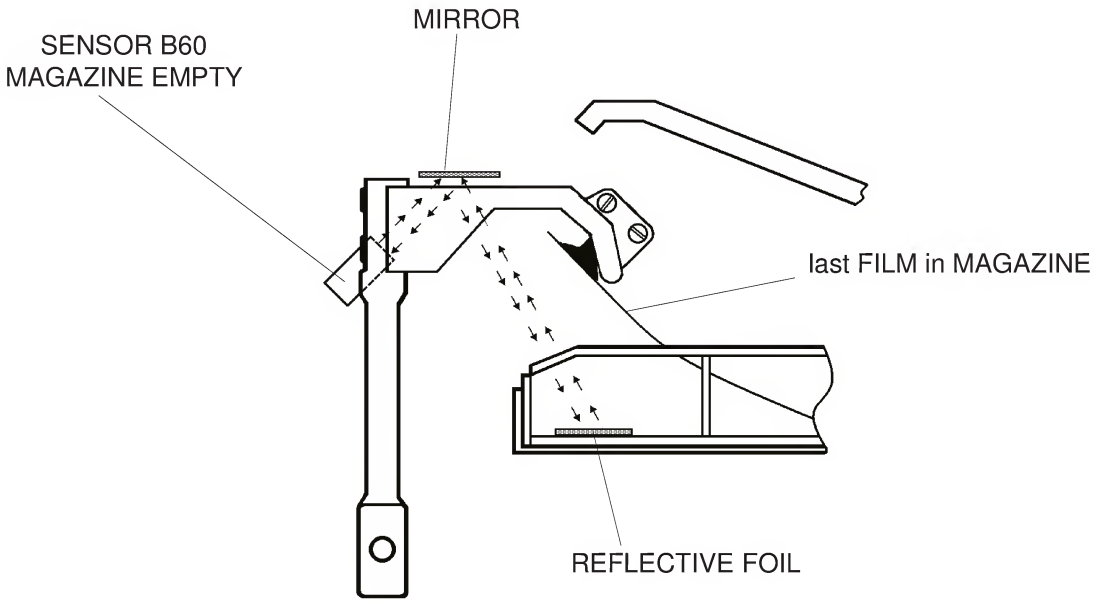


figure 1-19

B61/M_PU_FS Film At Sucker Bar

This sensor is placed on the Magazine Sucker Bar. The purpose of Sensor B61/M_PU_FS is to detect a film at the sucker bar of the Film Pocket. The output of Sensor B61 is used in several steps of the cycle of the Film Pocket:

To detect that the Film Pocket Sucker Bar has reached the film stack in the magazine: Since the height of the film stack in the magazines varies there is no fixed position for the Film Pocket for picking up the film from the magazine. Therefore after moving into the magazine the Film Pocket moves down until Sensor B61 is actuated. The Film Pocket stops after some additional steps of the stepper motor after Sensor B61 has been actuated. The purpose of the additional steps is to remove the clearance between the suckers and the film and to compensate for the tolerance of the sensor.

SENSOR B61 is also used to detect if the fresh film is removed from the Magazine Sucker Bar after it has been blown off into the cassette.

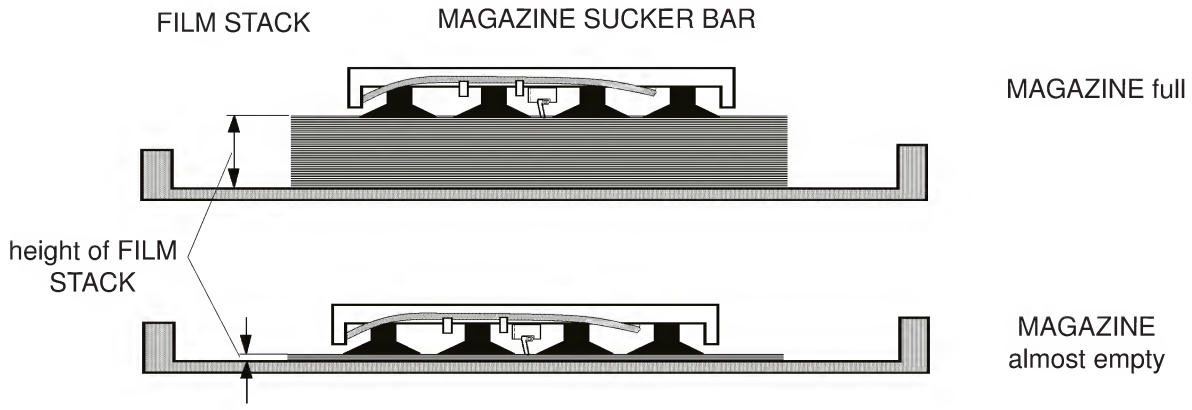


figure 1-20

B25 / B26 FILM DETECTOR SENSORS (ML300 Plus only)

The ENTRANCE ROLLERS of the integrated 3000RA Processor do not detect the LEADING EDGE of the FILM transported from the ML300 Plus to the PROCESSOR. The FILM DETECTOR SENSORS are now part of the ML300 Plus PROCESSOR INTERFACE.

FILM DETECTOR B25 (right) is connected to A8X32 and FILM DETECTOR B26(left) is connected to A8X24.

To handle the 2 SENSORS a OPERATING SOFTWARE version 5.14 or higher is required.

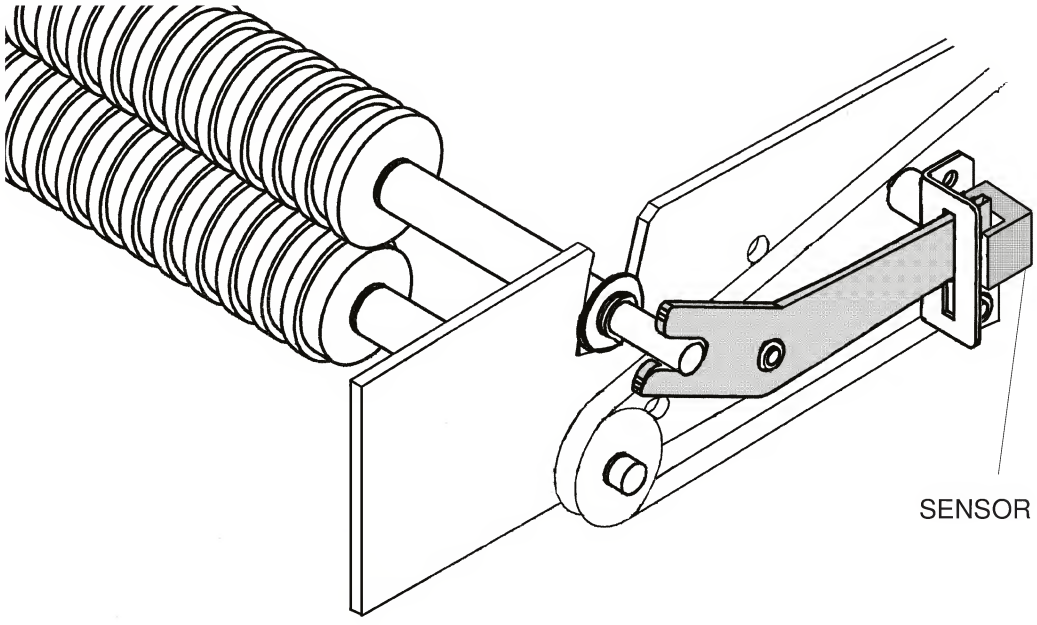


figure 1-21

ELECTRONIC SYSTEM

POWER SUPPLY

The power supply consists mainly of two transformers, two relays, three rectifiers, an EMI-filter, three interlock switches and several fuses. The power supply can be adapted to different voltages by changing the wiring at the transformers. The outputs of the power supply are 10 V DC, 30 V DC and 110 V AC (50/60 Hz). The DC-voltages are not regulated on the power supply. The voltages are regulated on the printed circuit boards. 10 V/DC non-regulated become 5 V/DC regulated and 30 V/DC non regulated become 24 V/DC regulated. The purpose of this is to increase the reliability of the electronics. The electronics on the printed circuit boards become less sensitive to noise on the wires from the power supply to the printed circuit boards. The electronic on the printed circuit boards becomes also less sensitive in relation to a voltage drop on the wires connecting the power supply with the printed circuit boards. The voltage regulation becomes also less expensive by this. The EMI-filter is used to protect the electronics from electrical noise from the line. The interlocks together with the relay k2 switch the 110 volts AC for safety. The relay K1 is controlled by the switch S1 (Main Switch Customer). The relay K1 switches the main power for the XML300 and the Film Processor 270RA. Only the 24 V/AC-line for the interlock switches are not switched by the relay K1. The fan for the venting of the system is turned on all the time as soon as the XML300 is connected to the AC-line.

PRINTED CIRCUIT BOARD A1

This is the Main Microprocessor Board. The following parts are installed to the circuit board:

A 80188 MICROPROCESSOR.

The microprocessor is used to drive all inputs, outputs and the program on this BOARD. The 80188 is a microprocessor that has an external 8 bit data bus and an internal 16 bit data bus. The microprocessor has an integrated Interrupt controller is used to generate a interrupt hierarchy for the peripheral circuits which communicate with the microprocessor. A wait state generator for adapting the microprocessor to the response time of periphery circuits. A quarz clock generator for the system clock frequency of 16 MHz. An address decoder to select the RAM-, E-PROM etc. Three timer circuits.

Three FLASH E-PROMS (only 2 for XML300 Plus) for the main program.

The Flash E-PROMS are components which store program data. The Flash E-PROMS can be electrically erased and programmed on the circuit board. The Flash E-PROMS can be programmed only in total. That means it is only possible to erase all data in the Flash E-PROMS at once to enable the circuit to be reprogrammed. Except for the function explained above, the Flash E-PROMS work similar to E-PROMS and PROMS.

A RAM section

to store parameters or performance data, like failures and cycle counter.

A battery

for the back up of the RAM memory. When the XML300 is switched off, the battery supplies the RAM with the power needed to keep the data in the memory. The life of the battery is approx. 7 to 10 years. In parallel to the battery there is a capacitor installed which can also supply the RAM with the voltage needed to keep the data. When the capacitor has been charged it can store the Charge needed for the memory for several hours. The advantage of this is that the data do not become lost when the battery is exchanged.

A REAL TIME CLOCK TIMER

used for the clock that displays the time and the date.

A PARALLEL INTERFACE

for communication with the Display and the User Keyboard.

FOUR RS 232 SERIAL INTERFACES

Two interfaces for the two Slave Processors. One interface for the communication with the processor in the Film Processor 270RA. One interface for the communication with the LAP TOP-computer. The communication between the microprocessor and the RS 232 interfaces is done by interrupt routines. All the interfaces have drivers installed between the microprocessor and the output.

A VOLTAGE REGULATION

(see description for the POWER SUPPLY).

AN E-PROM.

The E-PROM is a part of the memory that contains the bootstrap software of the microprocessor. There are for example the following routines:
Communication between RS 232 interfaces, communication between the parallel interfaces, programming of the Flash E-PROMS etc.

PRINTED CIRCUIT BOARD A2

This board is an interface between the printed circuit board A1 (Main Processor) and the display with the keyboard on the front panel of the -XML300.
On this board are:
Three bi-directional driver circuits to decouple the display and the keyboard from the microprocessor board. An adjustable DC/AC converter. This device converts the VCC = 5 V/DC to approx. 100 V/AC. The AC-voltage is used to adjust the backlight of the display. A DC/DC converter to generate from + 5 V/DC - 15 V/DC for the contrast of the display the contrast is adjustable by a potentiometer. A voltage regulator. An adjustable buzzer for acoustic indications.

PRINTED CIRCUIT BOARD A3 (SLAVE PROCESSOR)

This board contains the Slave Processor. There are two Slave Processors in the XML300. That means two printed circuit boards A3. The purpose of those boards is to monitor all the switches and sensors, to control motors and solenoids and to drive functional modules of the cycle. The Slave Processors are supervised by the Main Processor and they communicate with the Main Processor by a serial RS 232 interface. Following parts are installed to this board:

80535 Microprocessor:

This microprocessor is suited especially to drive processes because the microprocessor has six 8 bit ports and it has a very powerful set of commands to drive these ports.

A RESET CIRCUIT:

When the XML300 is switched on, this circuit resets the microprocessor and the 8255 interface circuit. The reset circuit can be also activated by pressing the reset switch on the printed circuit board.

A 8255 INTERFACE CIRCUIT

This circuit demultiplexes one port of the microprocessor. That means the eight bits of the port drive 24 bits on the interface circuit. An additional purpose is to decouple the periphery from the microprocessor.

An E-prom: •(see Master Processor)

An Flash E-prom •(see Master Processor)

A RAM: (see Master Processor)

A GAL 16V8 CIRCUIT

The GAL is a programmable integrated circuit. Once the GAL is programmed, the GAL behaves similar to C-MOS circuits. This circuit is used as a decoder to select the E-PROM, FLASH E-PROMS, the RAM or the 8255 Interface Circuit.

A MAX 232 DRIVER CIRCUIT

The purpose of this integrated circuit is to supply the RS 232 interface with the correct voltages.

PRINTED CIRCUIT BOARD A4 MAGAZINE INTERFACE

This board acts as an interface between the Slave Processor Board A3/2 and the sensors, motors, solenoids and valves which are controlled by the Slave Processor. All the signals between the Slave Processor Board A3/2 and the periphery become electrically decoupled by the Circuit Board A4. This is done by optocouplers which are using light instead of electric current for the transmission of the signal.

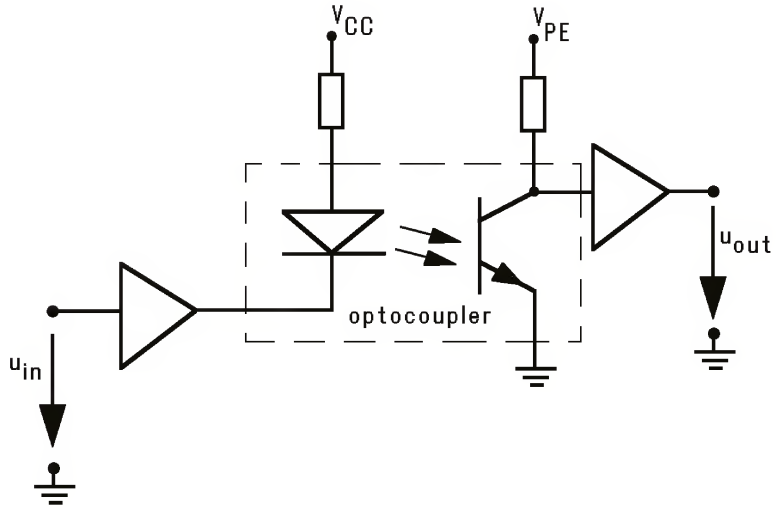
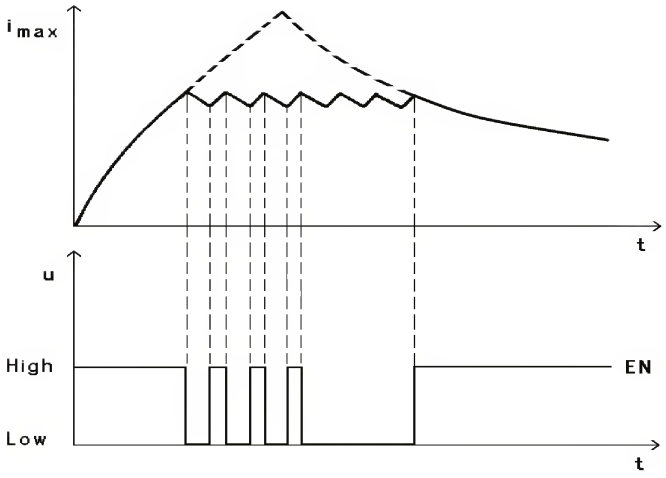


figure 1-22

Signals from the Slave Processor which are used to drive an output become amplified by the Circuit Board A4. The amplification of the signals for the motors is done by solid state relays. At the connection to the motors the solid state relays are connected in parallel to a voltage depending resistor (VDR). The resistance of the VDR depends on the height of the voltage at the VDR. The VDRs are used to protect the solid state relays from the inductive voltage generated by the motors and solenoids when they are switched. Two circuits to control and to drive the two stepper motors (Film Pocket and Processor Interface). The circuits consist mainly of one stepper motor controller (L297) and two driver circuits (L6202 or L6203). See figure next page. The circuits control the current of the stepper motor and they generate the phase shift needed for the four windings of the stepper motors. With the signal at the input HALF/FULL it is possible to select between half step mode and full step mode. At half step mode the step angle of the stepper motor is half the step angle of the full step mode. The Reset and Enable input are driven by the same signal. If the Enable is low the outputs A, B, C, D, INH1 and INH2 are low. The CTRL input is used to determine whether the chopper acts on INH1 and INH2 or on the phase lines A, B, C, D. The signal at the CTRL (control) input is always set to a high level that means the chopper acts always on the phase lines A, B, C and D. The chopper is needed for the limiting of the stepper motor current. The current is limited by switching off the motor each time, the current increases above a certain limit. The current remains switched off for a pulse time of the chopper signal. The chopper frequency is determined by the RC-combination at the pin OSC. The limit for the chopping of the current is determined by the voltage at pin No. 15 VREF. It can be adjusted by R38. The current sensing is done by the driver circuits (L6202/3) which supply the sensed current level by their SNS-outputs to the inputs SENS1/2 of the controller circuit (L297).



STEPPER MOTOR CURRENT

CHOPPER SIGNAL

figure 1-23

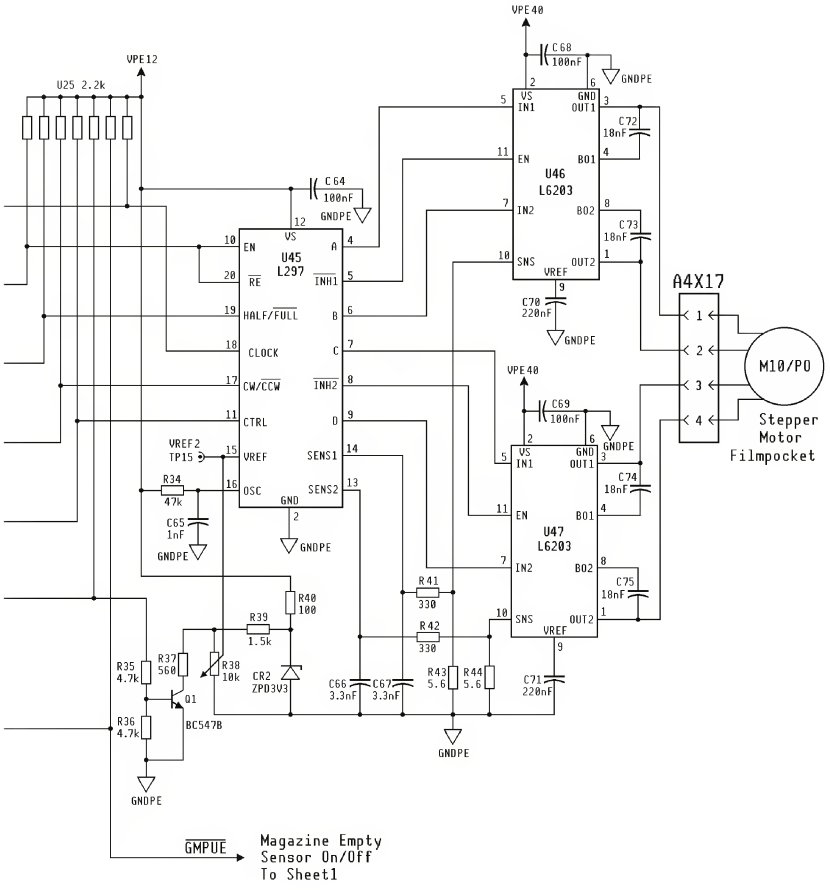


figure 1-24

PRINTED CIRCUIT BOARD A5 FILM POCKET

The circuit board A5 is located on the Magazine Film Pocket. The circuit board A5 has an internal 24 V regulator used to drive solenoids. The regulated supply voltage of 5 V is supplied by the printed circuit board A4 so there is no regulation for the 5 volts on the circuit board A5. On the circuit board there are the sensors B58/M_PU_ER, B57/M_PU_M and B56/M_PU_EF for the position detection of the magazine sucker bar. The sensor signals from the circuit board A7 are fed through the circuit board A5. All the signals from the sensors are connected to operational amplifiers to compensate for electrical noise and to determine the high level for the output of the sensors for voltages above 2.5 V and the low level for voltages below 2.5 V. The magazine empty sensor can be switched on and off by this circuit board. The integrated circuit L5832 together with its external components is used to control the current for the solenoid magazine sucker bar tilting.

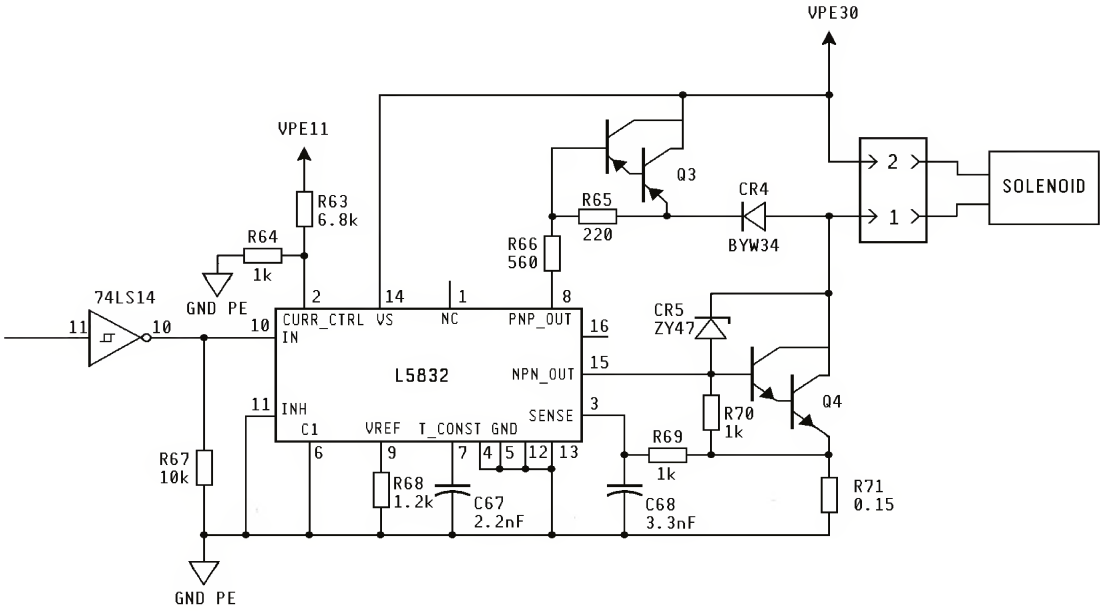


figure 1-25

The current needed to switch the solenoid is higher than the current needed to hold the solenoid in the position where it has been switched. The solenoid controller L5832 generates a current according to the right hand figure. The purpose of this solenoid controller is to reduce the heating of the solenoid when it is switched on.

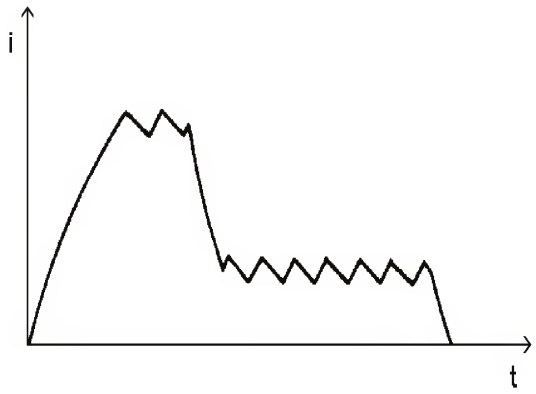


figure 1-26

PRINTED CIRCUIT BOARD A6/1-3 MAGAZINE SENSE

There are three Circuit Boards A6 in the XML300. The purpose of the Circuit Boards A6 is to sense the sizes of the Magazines inserted into the -XML300. The circuit boards A6 are also connected to the sensors for the detection of the magazine lid. The output of the signals from the circuit boards A6 are all switched in parallel.

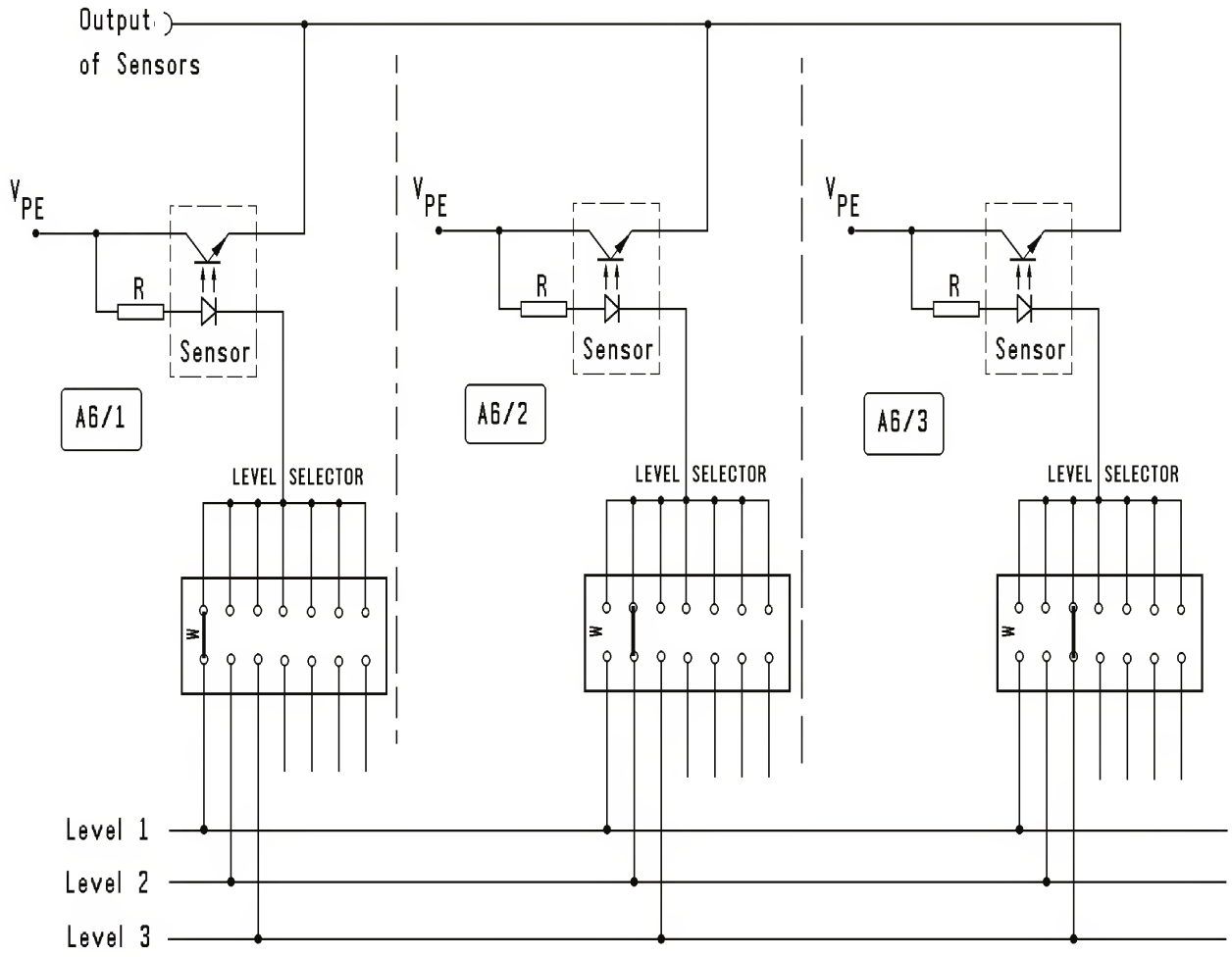


figure 1-27

Only one circuit board A6 will be active at one time. The multiplexing of the three circuit boards A6 is done by a signal at the cathodes of the transmitter diodes of the sensors. As long as there is a high signal at the cathodes of the transmitter diodes, the receiver transistor will be switched off, no matter if the sensor is interrupted or not. By switching the voltage at the cathodes of the transmitter diodes to ground, the sensors on the selected circuit boards A6 become active. Since the layout of the three A6 board are all the same there is a level selector necessary to determine the level of the circuit board. It is possible to code an A6 board for seven magazine levels though there are only three magazine levels in the XML300. This is because the printed circuit board A6 is also used in the XML 700 which contains seven magazines

PRINTED CIRCUIT BOARD A7 LEVEL CONTROL

This board contains only the three sensors for the position detection of the Film Pocket. (Home Position, Magazine/Cassette Level, End Switches, B30, B32, B31)

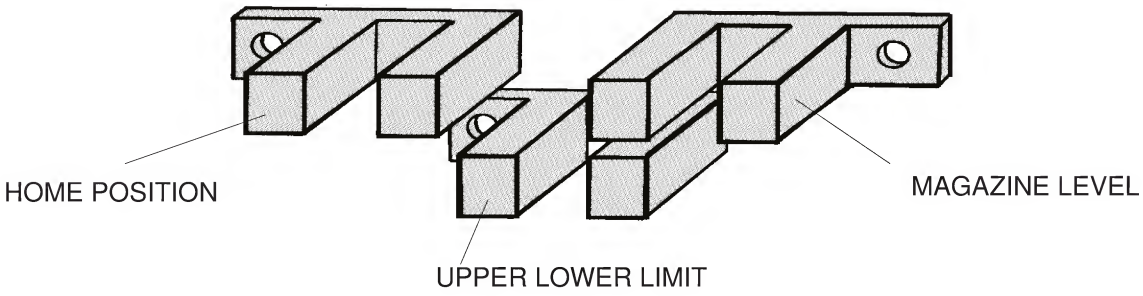


figure 1-28

PRINTED CIRCUIT BOARD A8 CASSETTE INTERFACE

This board is used as an interface between the slave Processor board A3/1 and the periphery like all sensors, motors and solenoids. For description of the circuits see Printed Circuit Board A4 Magazine Interface. For the solenoids Y7 (Tilting Sucker Bar) and Y4 (Cassette Opener) there is a solenoid controller L5832 used, for description see Printed Circuit Board A5 Film Pocket.

PRINTED CIRCUIT BOARD A9 DC MOTOR DRIVER

This board controls the two DC-motors M5 (Cassette Opening) and M2 (Cassette Input). The circuits on this board regulates also the current through the DC-motors. The motor become switched off, if the current exceeds a certain limit and the motor becomes switched on again a short time after this. This results in a chopped signal if the current reaches its maximum value.

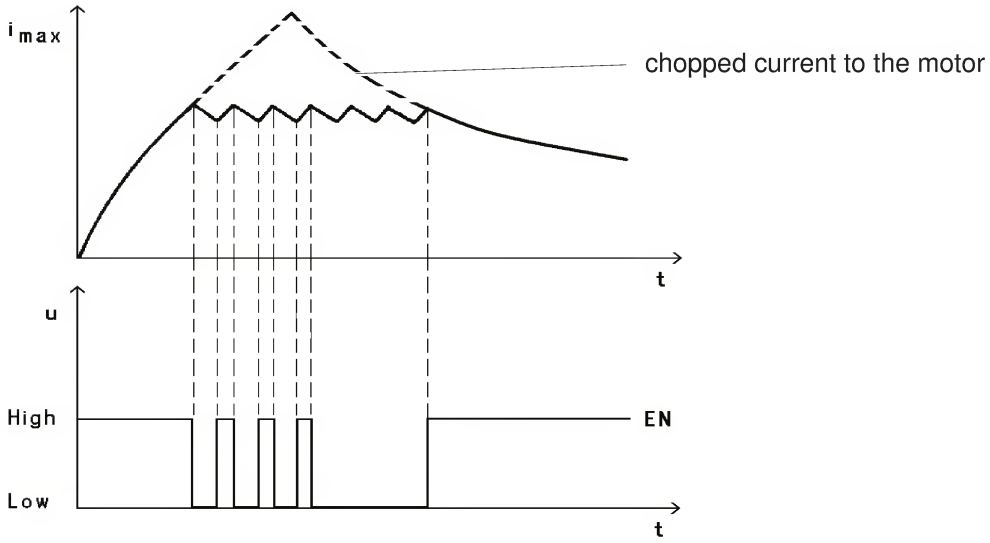


figure 1-29

The driver circuit L6203 is identical to the stepper motor controller on the circuit board A4 where it is used to drive the Film Pocket stepper motor. The signals at pin 11 (EN = enable of the L6203) and pin 10 (SNS = output of the sensed value of motor current) are used to limit the current when the motors are switched on or if they are mechanically blocked. The additional circuits LM339 and 74LS221 are used to determine the maximum current and the off-time for the chopping during current regulation. The operational amplifier LM339 acts as a comparator for to determine the maximum current. The circuit 74LS221 is used to determine the off-time during the chopping of the output of the driver L6203.

PRINTED CIRCUIT BOARDS A10/1-3 ODOMETER

These three boards contain the Odometer used for the Cassette Length and Cassette Width detection and the detection of the position of the Cassette Opener. The IC SFH910 contains a sensor and a circuit used to detect the direction of the rotation of the timing disc.

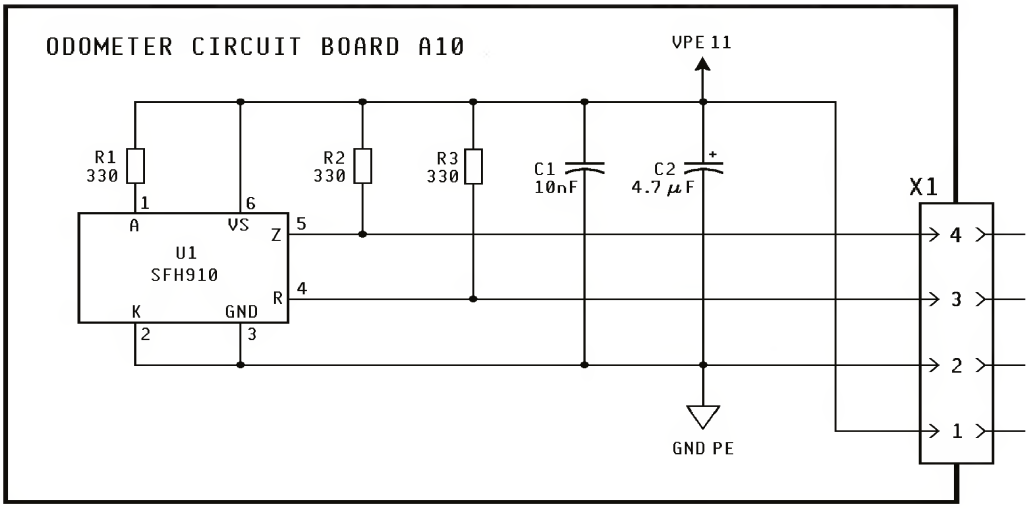


figure 1-30

CHAPTER 2

SOFTWARE

To understand the structure of the software it is very helpful to know something about the basic structure of the hardware. Therefore here is a short description of the hardware:

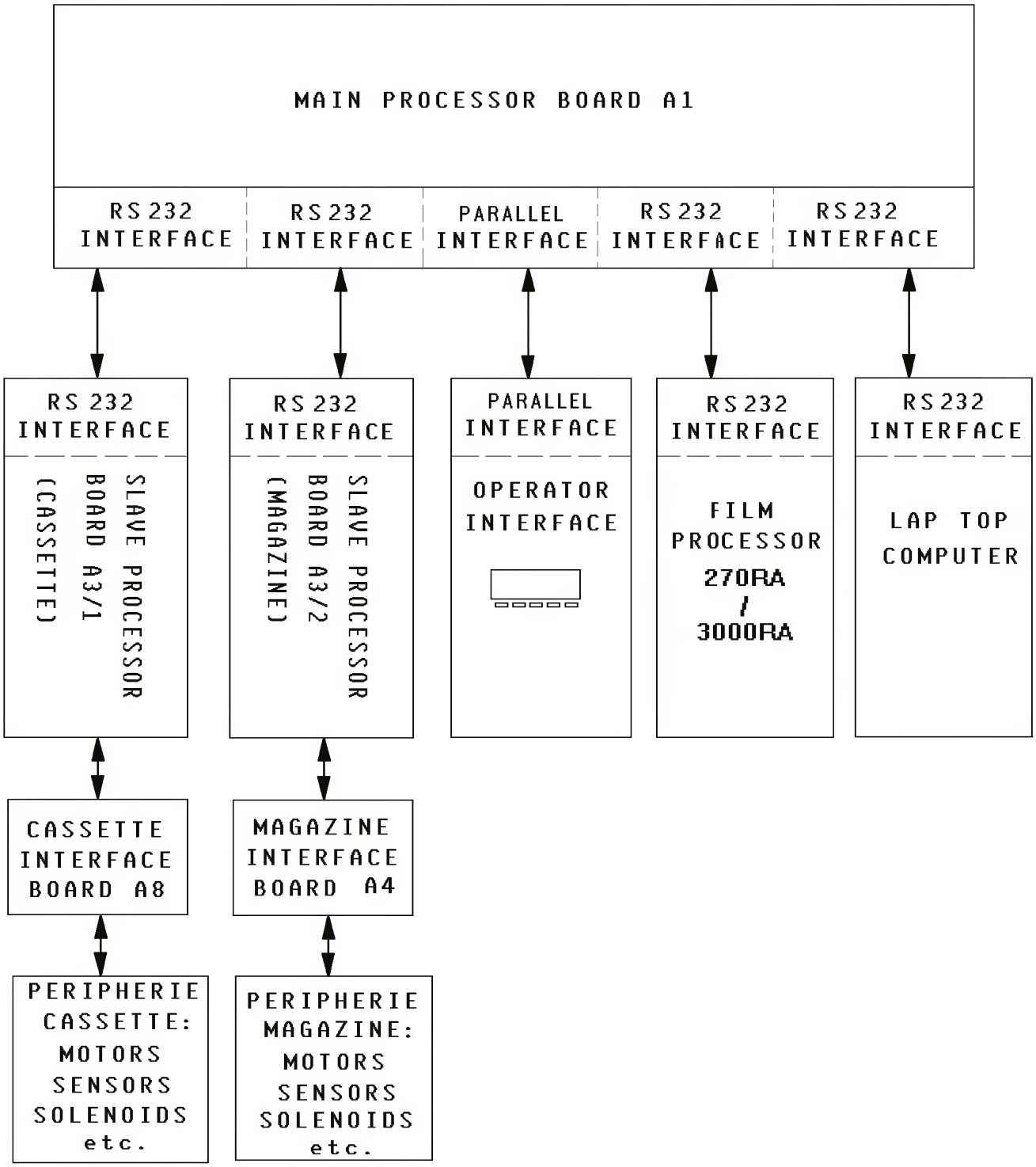


figure 2-1

The total XML300 system is controlled by the Main Processor Board A1. This Board communicates with the two slave processor board A3/1 and B3/2, the Display, the microprocessor board for the film processor 270RA / 3000RA and with the Lap Top computer. All synchronizing of the different microprocessor boards are performed by the main processor board A1.The program on the main processor board is a multi tasking program. This means that several functions can be operated in parallel. Of course these functions (they are called tasks) do not work independently, therefore the tasks interchange information which is needed for synchronization. These information exchanges are called events. The tasks on the main processor board A1 are shown in the figure below.

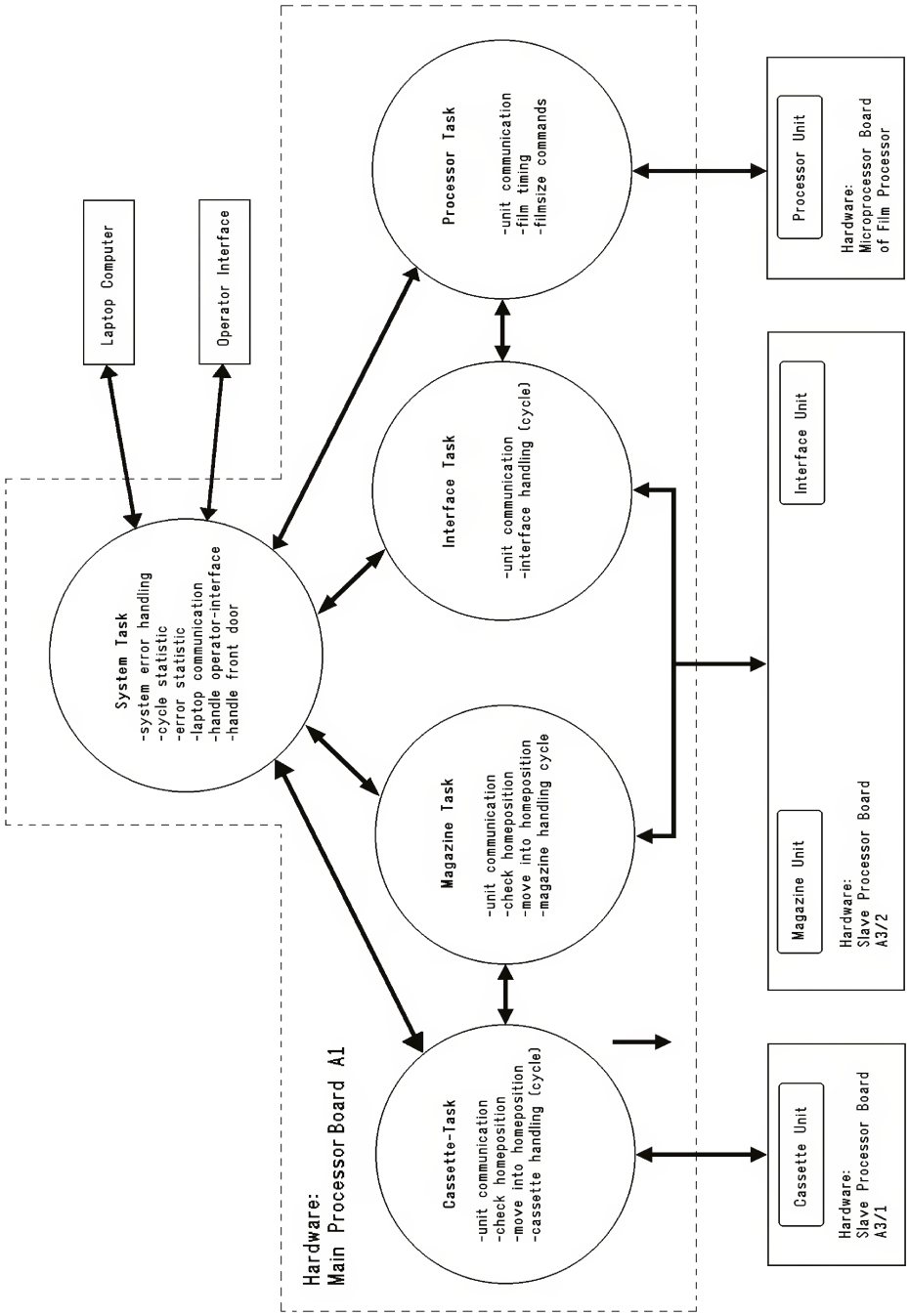


figure 2-2

Administrator Task

The Administrator Task takes control over the total XML300 system. The administrator task controls the complete XML300 in case of any error or failure of the system. The Administration Task communicates with all the other tasks and the Lap Top computer via events and mailboxes.

Cassette Task

This task controls the functions for the cassette (for example feed in cassette, open cassette etc.). The cassette task communicates with the administrator-, magazine-, and interface unit task via events and mailboxes. The cassette task starts an error handling in case of any error in a function of the cassette unit.

Magazine Task

This task controls the magazine unit (magazines, filmpocket). The magazine task communicates with the cassette task and administration task via events and mailboxes. The magazine task starts the error handling in case of any error in the magazine unit before the administration task takes control of the complete system.

Interface Task

The interface task controls the film chute and the processor interface. The interface task communicates with the cassette task and the administration task via events and mailboxes. The interface task also starts an error handling in case of any failure in the film chute or the processor interface.

Processor Task

The processor task controls the 270 RA processor.This task communicates with the cassette task, interface task and the administrator task via events and mailboxes. The processor task also starts an error handling in case of any error in the 270 RA processor.

Units

All the units are controlled by the tasks explained above. In the XML300 there are four units, the operator interface and the connection to the Laptop computer. The software for the four units is located on three microprocessor board. The programs for the units are split into routines which are controlled by the corresponding tasks. The routines work on the lowest level of the software. That means the details of the operation during a cycle are performed by these routines (in the following called functions). The functions switch the motors, solenoids etc. they check the sensors and they create error messages which are transmitted to the tasks for error handling. To illustrate how the software interacts, there is a simplified chart of part of a cycle shown in the figure next page.

Laptop Computer

The Lap Top Computer is not a part of the XML300 but it is used as a powerful diagnostic tool for trouble shooting and adjusting of the XML300. The Lap Top Computer communicates via a RS232 interface with the XML300. If the Lap Top Computer is connected to the XML300 it can be used to:

- Store statistics on hard disc
- Display statistics

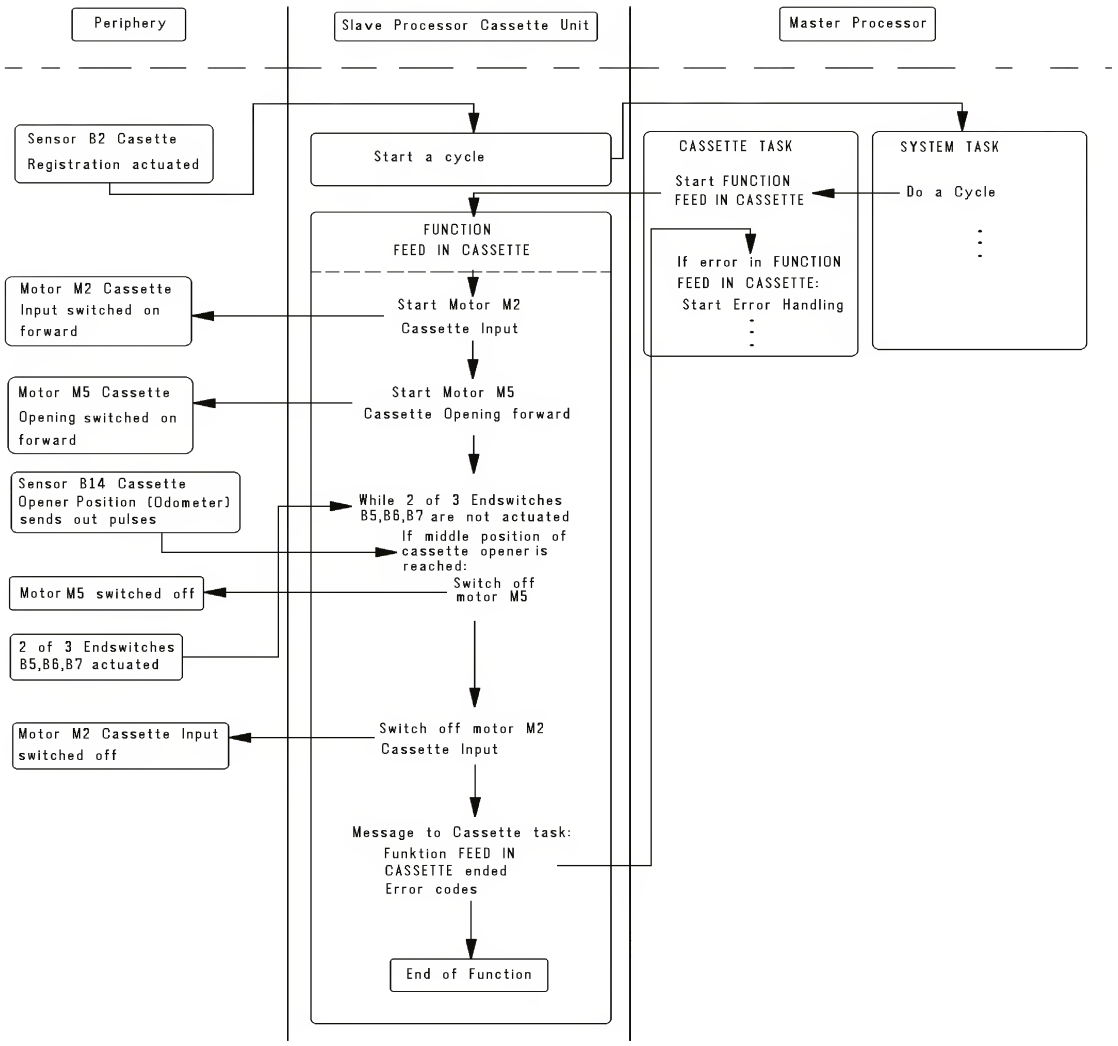

Periphery
Slave Processor Cassette Unit
Master Processor
Sensor B2 Casette Registration actuated
Start a cycle
CASSETTE TASK
Start FUNCTION FEED IN CASSETTE
SYSTEM TASK
Do a Cycle
FUNCTION FEED IN CASSETTE
If error in FUNCTION FEED IN CASSETTE: Start Error Handling
Motor M2 Cassette Input switched on forward
Start Motor M2 Cassette Input
Motor M5 Cassette Opening switched on forward
Start Motor M5 Cassette Opening forward
Sensor B14 Cassette Opener Position (Odometer) sends out pulses
While 2 of 3 Endswitches B5,B6,B7 are not actuated
If middle position of cassette opener is reached:
Motor M5 switched off
Switch off motor M5
2 of 3 Endswitches B5,B6,B7 actuated
Motor M2 Cassette Input switched off
Switch off motor M2 Cassette Input
Message to Cassette task: Funktion FEED IN CASSETTE ended Error codes
End of Function

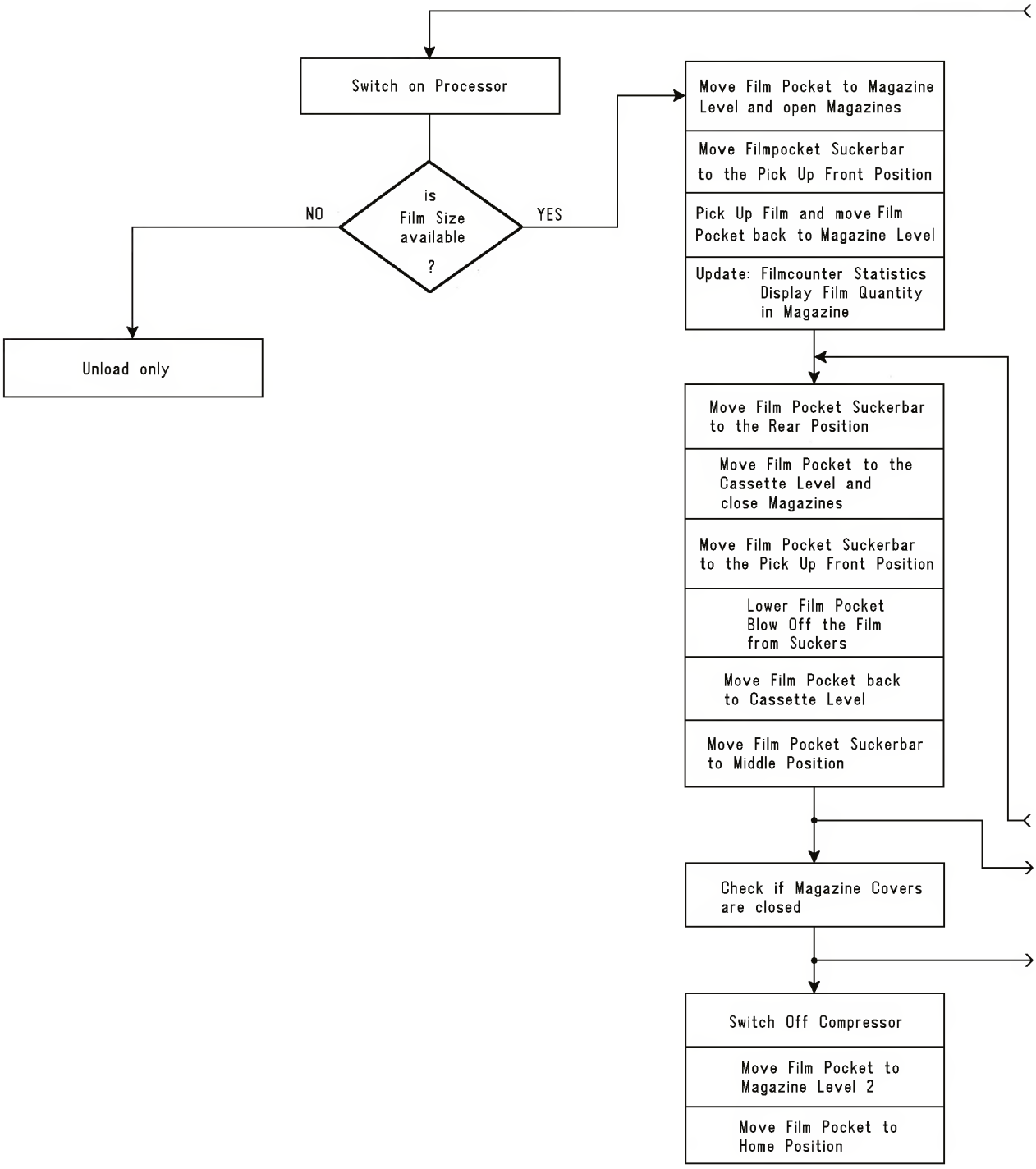
figure 2-3

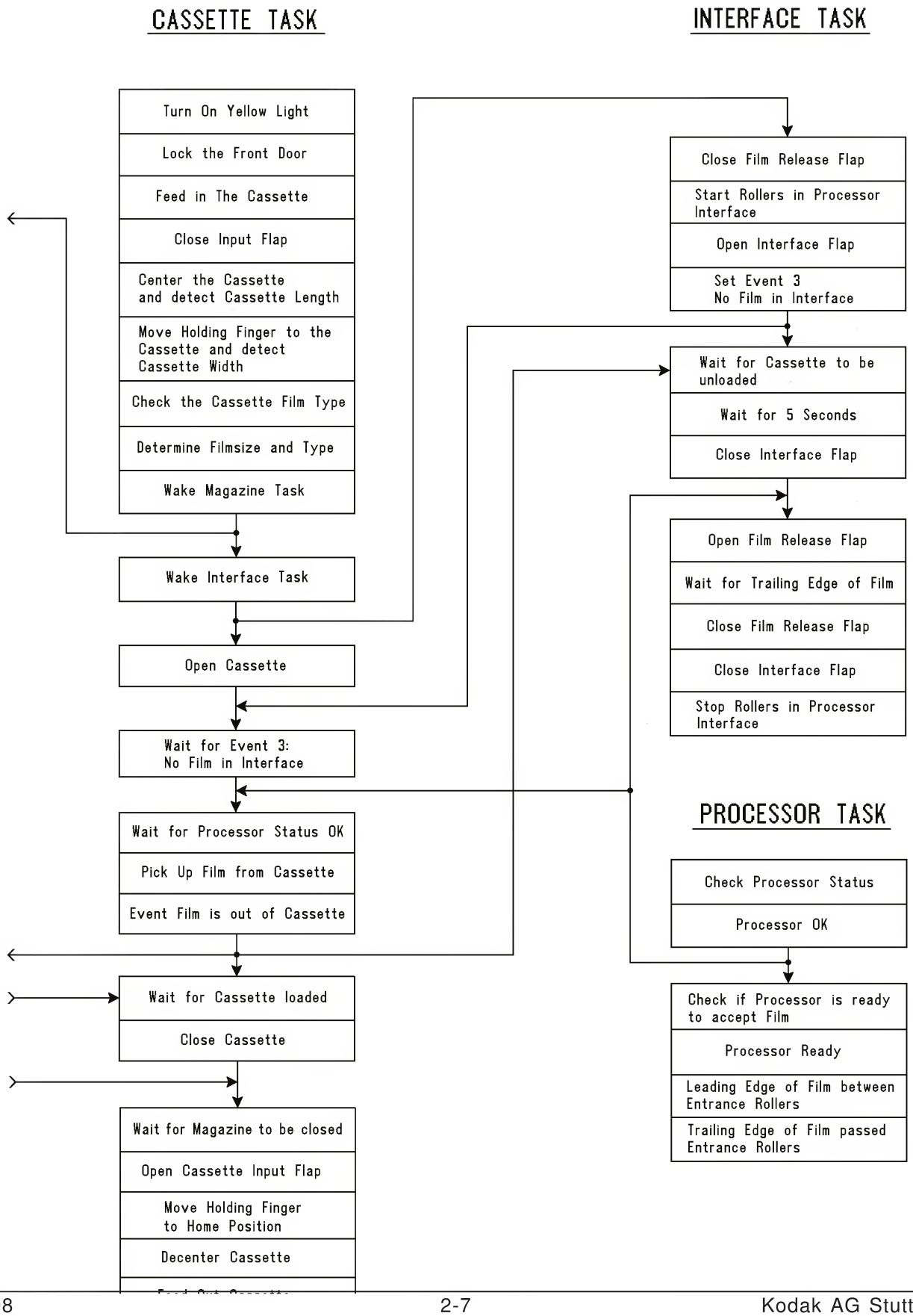
- Monitor Sensor signals (Sensor test)
- Switch components on/off
- Check components
- Trouble shooting etc.

Sequence of a normal cycle

The following chart is a simplified illustration of a normal cycle. Normal cycle means that a cassette with an exposed film is fed into the XML300 and there is a filled magazine with the corresponding film size inserted in the XML300. This is not a description of an unload only, load only, empty cassette/magazine or serial unload cycle. This is also a simplified description of the software sequences. The flow chart on the next page shows the Magazine, Cassette, Interface and Processor Task and the basic interaction between those tasks. The connections between the tasks illustrate the communication used for the synchronization of the tasks by using events.

MAGAZINE TASK


Switch on Processor
is Film Size available ?
NO
YES
Unload only
Move Film Pocket to Magazine Level and open Magazines
Move Filmpocket Suckerbar to the Pick Up Front Position
Pick Up Film and move Film Pocket back to Magazine Level
Update: Filmcounter Statistics
Display Film Quantity in Magazine
Move Film Pocket Suckerbar to the Rear Position
Move Film Pocket to the Cassette Level and close Magazines
Move Film Pocket Suckerbar to the Pick Up Front Position
Lower Film Pocket Blow Off the Film from Suckers
Move Film Pocket back to Cassette Level
Move Film Pocket Suckerbar to Middle Position
Check if Magazine Covers are closed
Switch Off Compressor
Move Film Pocket to Magazine Level 2
Move Film Pocket to Home Position


CASSETTE TASK
Turn On Yellow Light
Lock the Front Door
Feed in The Cassette
Close Input Flap
Center the Cassette and detect Cassette Length
Move Holding Finger to the Cassette and detect Cassette Width
Check the Cassette Film Type
Determine Filmsize and Type
Wake Magazine Task
Wake Interface Task
Open Cassette
Wait for Event 3: No Film in Interface
Wait for Processor Status OK
Pick Up Film from Cassette
Event Film is out of Cassette
Wait for Cassette loaded
Close Cassette
Wait for Magazine to be closed
Open Cassette Input Flap
Move Holding Finger to Home Position
Decenter Cassette
INTERFACE TASK
Close Film Release Flap
Start Rollers in Processor Interface
Open Interface Flap
Set Event 3 No Film in Interface
Wait for Cassette to be unloaded
Wait for 5 Seconds
Close Interface Flap
Open Film Release Flap
Wait for Trailing Edge of Film
Close Film Release Flap
Close Interface Flap
Stop Rollers in Processor Interface
PROCESSOR TASK
Check Processor Status
Processor OK
Check if Processor is ready to accept Film
Processor Ready
Leading Edge of Film between Entrance Rollers
Trailing Edge of Film passed Entrance Rollers

SEQUENCE OF OPERATION

Note

The sequence of events differs slightly from cycle to cycle. This is due to the fact that 3 independent micro processors are working in parallel(SYSTEM UNIT, CASSETTE UNIT and MAGAZINE UNIT). The events described here are from a normal cycle without errors.

CONDITIONS:

The described cycle is a normal cycle (unload/load).

The previous FILM is already out of the PROCESSOR.

18x24 X-Omatic CASSETTE.

18x24 MAGAZINE in level 1.

Parameter DISABLE OPENER = 00 (new PCB A9)

1. The operator feeds in a CASSETTE.

2. **SENSOR B2/C_IN_R CASSETTE REGISTRATION** is actuated and the following actions are started:

- The green light is switched off and the amber light is switched on and SENSOR B24/C_IN_R2 checks if there is a CASSETTE.
- The CASSETTE is transported to the 3 CASSETTE END SWITCHES **B5, B6 and B7.** At least 2 of them have to be actuated by the CASSETTE.
- The **HOLDING FINGER MOTOR M3/C_HF** is switched on to bring the HOLDING FINGER fully into its HOME POSITION. This is most important because the HOLDING FINGER is used to measure the cassette width.

Note

The CASSETTE OPENER MOTOR M5/C_OP is only started if the CASSETTE SUCKER BAR is in the rear position (e.g. SENSOR B18/C_PU_ER is actuated). This is a safety precaution to avoid damage of the CASSETTE SUCKER BAR.

- The **CASSETTE OPENER MOTOR M5/C_OP** is switched on to move the OPENER partially down. This is done to save time. The pulses generated by the **ODOMETER A10/3** determine the stop position of the CASSETTE OPENER. The counting of the pulses is started as soon as **SENSOR B15/C_OP_EO CASSETTE END SWITCH OPEN** is released.

3. The CASSETTE INPUT FLAP is closed. **Motor M1/C_IF** is switched on until **SENSOR B4/C_IF_EC** CASSETTE INPUT FLAP END SWITCH is actuated by the INPUT FLAP.

4. The **SOLENOID VALVE Y11/M_PU_B MAGAZINE BLOWING** is switched on. This opens the pressure line of the COMPRESSOR, because the COMPRESSOR cannot be started when there is pressure in the pressure line.

5. The **COMPRESSOR M16/M_CP** is turned on. The COMPRESSOR is turned on at this early time, because it takes some time to build up the pressure in the pneumatic system.

6. The **SOLENOID VALVE Y11/M_PU_B MAGAZINE BLOWING** is switched off.

7. CASSETTE CENTERING is started. If **SENSOR B10/C_CE_EO CENTERING BARS END SWITCH OPEN** is not actuated, the **CASSETTE CENTERING MOTOR M4/C_CE** is switched on in reverse to fully open the CENTERING BARS. This is important, because the travel of the CENTERING BARS gives the cassette length.

- The **CASSETTE CENTERING MOTOR M4/CE** is switched on in forward direction until **ENSORS B11/C_CE_CL** and **B12/C_CE_CR** are actuated by the CASSETTE. During this time the **ODOMETER A10/2** generates count pulses (cassette length pulses).
- After the CASSETTE is centred, the CASSETTE TYPE (Type 1 or 2) is detected. To do this the amount of reflective stickers at the LID COVER of the CASSETTE is counted (**SENSORS B21/C_T2_L and B22/C_T2_R**).
- The message " CASSETTE SUCCESSFULLY CENTRED " and the cassette length and the cassette type are sent back to the SYSTEM UNIT.

8. The **HOLDING FINGER MOTOR M3/C_HF** is switched on in forward direction. The HOLDING FINGER moves forwards and transports the CASSETTE fully to the cassette end stop. During this time the **ODOMETER A10/2** generates count pulses (cassette width pulses). **MOTOR M3** is switched off as soon as no more count pulses are generated, this means the HOLDING FINGER is stopped by the CASSETTE, and all 3 CASSETTE END SWITCHES B5, B6, and B7 are actuated. It is checked if the INPUT FLAP is closed. The message "INPUT FLAP AND HOLDING FINGER ARE OK " is sent back to the SYSTEM UNIT.

9. The MAGAZINE COVERS are checked to see if the MAGAZINES are closed. The message with the magazine status is sent back to the SYSTEM UNIT.

10. The FILM RELEASE in the FILM CHUTE is closed. The **MOTOR M12/M_PL_R FILM RELEASE** is switched on until the **SENSOR B34/M_PI_R FILM RELEASE CLOSED END SWITCH** is actuated. The message "FILM RELEASE CLOSED" is sent back to the SYSTEM UNIT.

11. The **STEPPER MOTOR PROCESSOR INTERFACE M13/M_PI** is switched on.

Note

In step 7 the cassette size was determined. This size is now used to select the correct MAGAZINE.

12. The FILM POCKET moves to the selected level (in this example to level 1) to pick up a fresh FILM. The message “FILMPOCKET REACHED THE SELECTED LEVEL” is sent back to the SYSTEM UNIT.

13. The INTERFACE FLAP MOTOR M11/M_PU_F is switched on for a certain amount of time to open the FLAP. The message “INTERFACE FLAP IS OPEN” is sent back to the SYSTEM UNIT.

14. All MAGAZINES are opened. The **MAGAZINE OPENING MECHANISM MOTOR M14/M_OP** is switched on, until **SENSOR B36/M_OP_EO MAGAZINE OPENING END SWITCH** is actuated. The message “MAGAZINE COVERS OPEN” is sent back to the SYSTEM UNIT.

15. The CASSETTE is opened.

- The **CASSETTE OPENING MOTOR M5/C_OP** was stopped in step 2 and is now switched on again. The CASSETTE OPENER moves down to its bottom position. The bottom position is determined by count pulses of the ODOMETER A10/3 (48 pulses).
- After the bottom position is reached, the **CASSETTE OPENER SOLENOID Y4/C_OP** is switched on.
- The **SOLENOID VALVE Y3/C_OP_B CASSETTE BLOWING** is switched on.
- The **CASSETTE OPENER MOTOR M5/C_OP** is switched on in reverse direction to lift the CASSETTE LID.
- After the BLOW POSITION is reached, determined by count pulses of the ODOMETER A10/3 the **CASSETTE OPENER MOTOR M5/C_OP** is stopped
- Air is now blown into the CASSETTE to separate the FILM from the LID SCREEN. The total blow time depends on the setting of the PARAMETER BLOW TIME.
- The **CASSETTE OPENER MOTOR M5/C_OP** is switched on again and the OPENER moves up to the upper position (HOME POSITION). Motor M5/C_OP is switched off as soon as **SENSOR B15/C_OP_EO** is reached. The **CASSETTE OPENER SOLENOID Y4/C_OP** is switched off.
- **SENSOR B16** is closed and the message “CASSETTE IS OPEN” is sent back to the SYSTEM UNIT.

16. The **ROLLER MOTOR M7/C_PU_RO** in the CONVEYOR is switched on.

16. The **ROLLER MOTOR M7/C_PU_RO** in the CONVEYOR is switched on.

17. The MAGAZINE SUCKER BAR rotates into the MAGAZINE. **MOTOR M15/M_PU MAGAZINE FILM PICK UP** is switched on. The FILM POCKET waits in the so called PICK UP POSITION. The fresh FILM will be picked up after the exposed FILM is unloaded from the CASSETTE. The message "FILM POCKET SUCKER BAR REACHED THE PICK UP POSITION" is sent back to the SYSTEM UNIT.

18. The exposed FILM is picked up from the CASSETTE.

- The **SOLENOID VALVES Y5/C_PU_S** and **Y6/C_PU_VE** are energised. This allows the vacuum to built up after the CASSETTE SUCKERS reached the FILM in the CASSETTE.
- The **FILM PICK UP MOTOR M6/C_PU** is switched on in forward direction. The CASSETTE SUCKER BAR CARRIAGE travels forward into the CASSETTE.
- 300 msec after the start of MOTOR M6, the **SOLENOID Y7/C_PU SUCKER BAR TILTING** is energised. This tilts the CASSETTE SUCKER BAR.
- When **SENSOR B17/C_PU_EF FILM PICK UP END SWITCH FRONT** is reached, the FILM PICK UP MOTOR M6/C_PU is switched off. A pause of 500 msec is started.
- The **SOLENOID Y7/C_PU** is switched off. This causes the CASSETTE SUCKER BAR to tilt back and to separate the FILM from the CASSETTE SCREEN. **SENSOR B19** is checked.
- The **FILM PICK UP MOTOR M6/C_PU** is switched on in backward direction.
- The CASSETTE SUCKER BAR ASSEMBLY travels backwards.
- The FILM interrupts the **SENSOR B20/C_PU_VO VACUUM OFF**.
- The VACUUM OFF TIME is started.
- At the end of the VACUUM OFF TIME the **SOLENOID VALVES Y5/C_PU_S** and **Y6/C_PU_VE** are switched off. This vents the vacuum system. The FILM is released from the CASSETTE SUCKERS and is picked up by the CONVEYOR FRONT ROLLERS and is transported to the FILM CHUTE.
- After **SENSOR B18/C_PU_ER FILM PICK UP END SWITCH REAR is** actuated the **FILM PICK UP MOTOR M6/C_PU** is switched off.
- After **SENSOR B20/C_PU_VO VACUUM OFF** saw the trailing edge of the FILM, the message FILM OUT OF THE CASSETTE" is sent back to the SYSTEM UNIT.

19. A fresh FILM is picked up in the MAGAZINE.

- The **SOLENOID VALVE Y11/M_PU_B MAGAZINE BLOWING** is energised. Air is now blown through the MAGAZINE BLOW PIPES to separate the FILMS in the MAGAZINE.

- The **SOLENOID VALVE Y12/M_PU_S MAGAZINE SUCKING** is energised. This allows a built up of the vacuum after the MAGAZINE SUCKER BAR reaches the top FILM in the MAGAZINE.
- The **SOLENOID Y14/M_PU** is energised. This tilts the MAGAZINE SUCKER BAR.
- The **STEPPER MOTOR FILM POCKET M10/M_PO** is started and and the FILM POCKET moves down towards the FILMS.
- The FILM POCKET SUCKER BAR reaches the top FILM and **SENSOR B61/M_PU_FS FILM AT SUCKER BAR** is actuated.
- The FILM POCKET moves further down depending on the PARAMETER ADDITIONAL STEPS. This ensures that the SUCKERS are in good contact with the FILM and that the vacuum can be built up.
- The **STEPPER MOTOR FILM POCKET M10/M_PO** is switched off.
- It is checked if the MAGAZINE is NEARLY EMPTY.
- After a pause of 100 msec the **STEPPER MOTOR FILM POCKET M10/M_PO** is started in upwards direction, until the TILT POSITION is reached. **SENSOR B61/M_PU_FS** is checked
- The **STEPPER MOTOR FILM POCKET M10/M_PU** is switched off.
- The **SOLENOID Y14/M_PU** is switched off.
- 150 msec later the **SOLENOID VALVE Y11/M_PU_B** is switched off. Air is no longer blown into the MAGAZINE.
- The **STEPPER MOTOR FILM POCKET M10/M_PO** is switched on again to reach the move out position.
- The **STEPPER MOTOR FILM POCKET M10/M_PO** is switched off when the MOVE OUT POSITION is reached.
- After a pause of 100 msec the **DOUBLE SHEET DETECTION SOLENOID Y15/M_PU_DS** is energised. The DOUBLE SHEET DETECTOR moves forward to detect if one or more FILMS are picked up.
- 200 msec later **SOLENOID Y15/M_PU_DS** is switched off.
- It is now checked if the MAGAZINE is empty.
- The message “FILM POCKET SUCKER BAR REACHED THE MOVE OUT POSITION” is sent back to the SYSTEM UNIT.

20. The INTERFACE FLAP becomes closed. The **MOTOR M11/M_PU_F INTERFACE FLAP** is switched on. The FLAP is closed and **SENSOR B33/M_PI_F INTERFACE FLAP CLOSED END SWITCH** is interrupted. MOTOR M11 is switched off. The message “INTERFACE FLAP IS CLOSED” is sent back to the SYSTEM UNIT.

21. The FILM POCKET SUCKER BAR with the fresh FILM is rotated out of the MAGAZINE.

- MOTOR M15/M_PU MAGAZINE FILM PICK UP is switched on in reverse direction.
- **SENSOR B58/M_PU_ER FILM PICK UP END SWITCH REAR** is reached.
- **MOTOR M15/M_PU_ER** is switched off.
- The message “FILM POCKET SUCKER BAR REACHED THE REAR POSITION” is sent back to the SYSTEM UNIT.

22. The FILM POCKET moves to the CASSETTE LEVEL. The **STEPPER MOTOR FILM POCKET M10/M_PO** receives the calculated amount of pulses to move the FILM POCKET up to the CASSETTE LEVEL. **SENSOR B32/M_PO_ML MAGAZINE LEVELS** monitors in addition the amount of levels between the MAGAZINE LEVEL and the CASSETTE LEVEL. The STEPPER MOTOR M10 is switched off as soon as the FILM POCKET reaches the CASSETTE LEVEL. During the upward movement of the FILM POCKET, the MAGAZINES become closed. **MOTOR M14/M_OP MAGAZINE OPENING** is switched on. The message “FILM POCKET REACHED THE CASSETTE LEVEL” is sent back to the SYSTEM UNIT.

23. The FILM POCKET SUCKER BAR is rotated into the open CASSETTE.

- MOTOR M15/M_PU FILM PICK PICK UP is switched on in forward direction.
- MOTOR M15/M_PU is switched off as soon as SENSOR B56/M_PU_EF FILM PICK UP END SWITCH FRONT is reached.
- The message “FILM POCKET SUCKER BAR REACHED THE FRONT POSITION” is sent back to the SYSTEM UNIT.

24. Depending on the amount of steps given in the PARAMETER LOWER POCKET the FILM POCKET is lowered. This hinders the fresh FILM from floating out of the CASSETTE.

- The STEPPER MOTOR FILM POCKET M10/M_PO receives the desired amount of pulses to move the FILM POCKET down.
- The message “FILM POCKET IS LOWERED” is sent back to the SYSTEM UNIT.

25. The FILM is blown off from the SUCKERS.

- The SOLENOID VALVE Y10/M_PU_BS MAGAZINE BLOW SUCKER is switched on for 200 msec. This frees the FILM from the SUCKERS. The blowing may be repeated up to 10 times (1 sec blow 0.5 sec pause) if **SENSOR B61/M_PU_FS FILM AT SUCKER BAR** is not deactuated.

- The message “FILM IS BLOWN OFF FROM THE FILM POCKET SUCKER BAR SUCKERS” is send back to the SYSTEM UNIT.

26. **The COMPRESSOR M16/M_CP** is switched off.

27. The FILM POCKET SUCKER BAR is tilt back. **SOLENOID Y14/M_PU SUCKER BAR TILTING** is switched off.

28. The FILM POCKET SUCKER BAR is transported to the MOVE OUT POSITION. It has to be transported up, so that it can be rotated out of the CASSETTE. **MOTOR M10/M_PO STEPPER MOTOR FILM POCKET** is switched on in upward direction, until the CASSETTE LEVEL BRACKET interrupts **SENSOR B32/M_PO_ML MAGAZINE LEVEL**. The message “FILM POCKET REACHED THE MOVE OUT POSITION” is sent back to the SYSTEM UNIT.

29. The FILM POCKET SUCKER BAR is rotated to the MIDDLE POSITION. **MOTOR M15/M_PU MAGAZINE FILM PICK UP** is switched on in reverse direction. The MOTOR is switched off as soon as **SENSOR B57/M_PU_M FILM PICK UP MIDDLE POSITION** is no longer interrupted. The message “FILM POCKET SUCKER BAR REACHED THE MIDDLE POSITION” is sent back to the SYSTEM UNIT.

30. It is checked if the MAGAZINES are really closed. The message “MAGAZINE COVERS ARE CLOSED” is sent back to the SYSTEM UNIT.

31. The **SOLENOID VALVES Y10/M_PU_BS** and **Y11/M_PU_B** are switched on to vent the pressure system.

32. In step 18 the exposed FILM was transported into the FILM CHUTE. The FILM was there held back by the FILM RELEASE. The **FILM RELEASE MOTOR M12/M_PI_R** was switched on already at this time. The exposed FILM enters the PROCESSOR INTERFACE and is transported to the PROCESSOR. SENSOR B35/M_PI_B FILM IN INTERFACE BOTTOM detects the trailing edge of the FILM. The message “FILM TRAILING EDGE IS RECOGNISED IN THE FILM CHUTE” is sent back to the SYSTEM UNIT.

33. The **CASSETTE OPENER MOTOR M5/C_OP** is started downward to close the CASSETTE. The pulses from the **ODOMETER A10/3** are counted, after **SENSOR B15/C_OP_EO** is deactuated, to reach the bottom position of the CASSETTE OPENER. This closes the **CASSETTE. MOTOR M5/C_OP** is switched off. After a pause of 100 msec **MOTOR M5/C_OP** is switched on in upward direction. **MOTOR M5/C_OP** is switched off as soon as **SENSOR B15/C_OP_EO** becomes actuated. This means the CASSETTE OPENER is in the upper position. The message “CASSETTE IS CLOSED” is sent back to the SYSTEM UNIT.

34. The CASSETTE INPUT FLAP is opened. **MOTOR M1/C_IF CASSETTE INPUT FLAP** is switched on until the **SENSOR B3/_IF_EO CASSETTE INPUT FLAP END SWITCH OPEN** is actuated.

35. The FILM RELEASE in the FILM CHUTE is closed. **MOTOR M12/M_PI_R FILM RELEASE** is switched on until the **SENSOR B34/M_PI_R** is interrupted. The message "FILM RELEASE IS CLOSED" is sent back to the SYSTEM UNIT.

36. The FILM POCKET moves to MAGAZINE LEVEL 2. MAGAZINE LEVEL 2 is close to the HOME POSITION and is reached quite fast. The **STEPPER MOTOR FILM POCKET M10/M_PO** receives the calculated amount of pulses to move the FILM POCKET from the CASSETTE LEVEL to MAGAZINE LEVEL 2. **SENSOR B32/M_PO_ML MAGAZINE LEVELS** monitors in addition the amount of calculated levels between the CASSETTE LEVEL and MAGAZINE LEVEL 2. The STEPPER MOTOR M10 is switched off as soon as the FILM POCKET reaches MAGAZINE LEVEL 2. The message "FILM POCKET REACHED THE SELECTED LEVEL" is sent back to the SYSTEM UNIT.

37. The **HOLDING FINGER MOTOR M3/C_HF** is switched on in backward direction. During the backward movement the pulses from the **ODOMETER A10/1** are monitored. As soon as the HOLDING FINGER stops at the mechanical end stop, the ODOMETER A10/1 stops generating pulses. This is the stop condition for MOTOR M3. The message "HOLDING FINGER MOVED BACKWARD AND STOPPED AT THE END STOP" is sent back to the SYSTEM UNIT.

38. The **STEPPER MOTOR FILM POCKET M10/M_PO** receives pulses to move the FILM POCKET to the HOME POSITION. HOME POSITION is reached as soon as **SENSOR B30/M_PO_HP HOME POSITION** is interrupted. MOTOR M10 is stopped. The message "FILM POCKET REACHED THE HOME POSITION" is sent back to the SYSTEM UNIT.

39. The **SOLENOID VALVES Y10/M_PU_BS** and **Y11/_PU_B** are switched off. Venting of the pressure system is ended.

40. It is checked if the MAGAZINE UNIT is in HOME POSITION. The FILM POCKET must be in HOME POSITION and the status of the following SENSORS must be:

- B36/M_OP_EO MAGAZINE OPENING END SWITCH OFF
  B37/M_OP_EC MAGAZINE CLOSING END SWITCH ON
  B56/M_PU_EF FILM PICK UP END SWITCH FRONT OFF
  B57/M_PU_M FILM PICK UP MIDDLE POSITION OFF
  B58/M_PU_ER FILM PICK UP END SWITCH REAR ON
- The message "MAGAZINE UNIT IN HOME POSITION" is sent back to the SYSTEM UNIT.

41. The CASSETTE is fed out. The **CASSETTE INPUT MOTOR M2/C_IN** is switched on and the CASSETTE is transported out of the ML300. The CASSETTE actuates **SENSOR B2/C_IN_R CASSETTE REGISTRATION** and MOTOR M2 is switched off.

42. Some time later the **STEPPER MOTOR PROCESSOR INTERFACE M13/M_PI** is switched off.

43. When the OPERATOR takes out the **CASSETTE SENSOR B2(C_IN_R CASSETTE REGISTRATION** is deactuated and at the OPERATOR CONTROL PANEL the green light is turned on. A new cycle can be started.

44. In standby cyclic checks are made to see if the CASSETTE UNIT and the MAGAZINE UNIT are in HOME POSITION.

Kodak AG
Hedelfinger Str. 54-60
70327 Stuttgart
Germany

Kodak, Min-R, X-Omat and X-Omatic are trademarks

CUSTOMER EQUIPMENT SERVICES KODAK AG STUTTGART